U.S. Department of the Interior
Bureau of Land Management

Medford District Office
3040 Biddle Road
Medford, Oregon 97504

April 2001

Cascade-Siskiyou National Monument

Draft Study of Livestock Impacts on the Objects of Biological Interest

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
MEDFORD DISTRICT OFFICE
3040 BIDDLE ROAD
MEDFORD, OREGON 97504

IN REPLY REFER TO:
6240(114)
CSNM Study Plan
A6409(TH:jl)

Dear Reader:

The Cascade-Siskiyou National Monument (CSNM) was established on June 9, 2000 when President William J. Clinton issued a Presidential Proclamation (Proclamation 7318 of June 9, 2000) under the provisions of the Antiquities Act of 1906. The Cascade-Siskiyou National Monument covers 52,947 acres of federal land in southwest Oregon. These federal lands are managed by the Bureau of Land Management's Medford District Office. The Proclamation directed the Secretary of the Interior through the BLM to "study the impacts of livestock grazing on the objects of biological interests in the Monument with specific attention to sustaining the natural ecosystem dynamics." This Draft Study of Livestock Impacts on the Objects of Biological Interest in the Cascade-Siskiyou National Monument (Draft Grazing Impacts Study) is the initial effort to fulfilling the directions of the Proclamation.

This Draft Grazing Impacts Study is a conglomerate of monitoring projects designed to establish a baseline of site specific information on important biological objects, resources and processes in the Monument. Landscape-level surveys will be used to extrapolate results from the site specific studies the larger Monument landscape. Other projects will try to replicate previous studies to determine changes that have occurred over time. Most monitoring projects will be completed in five years although a subset of the projects will be integrated into the long-term monitoring in the Monument.

The Draft Grazing Impacts Study is not part of the CSNM Draft Resource Management Plan as there is no National Environmental Policy Act (NEPA) requirement for its inclusion. The Draft Grazing Impacts Study will be reviewed by a peer group and public comments will be evaluated before it becomes final and is fully implemented. Although the Draft Grazing Impacts Study is not part of the CSNM DRMP/DEIS, the information gathered and conclusions from the study may be used in a future resource management plan amendment pertaining to the management of livestock grazing in the Monument. **We welcome your input on the Draft Study of Livestock Impacts on the Objects of Biological Interest in the Cascade-Siskiyou National Monument. Written comments on this document will be accepted until July 1, 2001.**

Written comments pertaining to the Draft Study of Livestock Impacts on the Objects of Biological Interest in the Cascade-Siskiyou National Monument should be sent to:

Ted Hass, CSNM Team Leader
3040 Biddle Road
Medford, Oregon 97504

or comments may be e-mailed to Ted_Hass@or.blm.gov

Sincerely,

Richard J. Drehobl
Interim Monument Manager
Cascade-Siskiyou National Monument

Sincerely,

Ron Wenker
District Manager
BLM Medford District

TABLE OF CONTENTS

I. INTRODUCTION

The Presidential Proclamation calls for the protection of a range of biological elements that are dependent on continued ecological integrity of the Cascade-Siskiyou National Monument (CSNM) for their survival. The biological elements include: Greene's Mariposa lily, Gentner's fritillary, Bellinger's meadowfoam, populations of long isolated fish species, special plant communities (rosaceous chaparral and Oregon white oak-juniper woodlands), mixed conifer, winter deer habitat, "old-growth conifer habitat crucial for spotted owl," as well as the diversity of butterfly and snail species associated with the assemblage of plant communities dispersed across the landscape.

The Presidential Proclamation identifies the need to "study the impacts of livestock on the objects of biological interest in the Monument with specific attention to sustaining the natural ecosystem dynamics." To fulfil these requirements with limited resources, this study plan prescribes monitoring of selected biological elements as well as representative areas of the landscape while considering the range of ecological issues and interests. Landscape-level surveys will be used to extrapolate results gained from site specific studies to the larger landscape. This involves a multi-disciplinary approach for assessing livestock impacts to the CSNM landscape. Monitoring projects not directly related to livestock issues are presented in the Cascade-Siskiyou National Monument Draft Resource Management Plan/Draft Environmental Impact Statement (USDI 2001).

Indicators of ecosystem integrity depend greatly on the objectives of interest indicating the need to collect and analyze data meeting the varied needs of scientists. Thus, the condition of plant communities grazed by livestock will be assessed following recognized BLM methodology for rangeland condition assessment, while also considering impacts to rare species, special plant communities/habitats, ensuring ecosystem functioning standards (water quality, stubble height and the ability of riparian systems to retain sediments, etc), and effects on other ecosystem processes such as weed invasion.

A Description of the Cascade-Siskiyou National Monument

The Cascade-Siskiyou National Monument (CSNM) consists of 52,947 acres of federal land administered by the BLM in southern Jackson County, Oregon (map 1). The CSNM is located in the Klamath and Rogue River basins and four watersheds that have a combined total of approximately 780 miles of streams. The topography of the CSNM is variable with the area around Agate Flat being nearly level to slopes in excess of seventy percent along the head walls of creeks in the Klamath River-Iron Gate watershed. Elevation ranges from 2,400 feet along Emigrant Creek to 6,134 feet at the top of Chinquapin Mountain. Average annual precipitation for this area ranges from 24 to 46 inches with most coming in the form of rain below 3,500 feet and snow about that level.

The CSNM is noted for its biological and ecological diversity because of its location at the confluence of the Klamath Mountains, Cascade Mountains and the Great Basin Geological Provinces. Each geological province provides its own special assemblage of organisms and ecological processes known as ecoregions which are based on geology, climate, soils, flora and fauna, elevation, and land use. There are three ecoregions identified in the CSNM having particular biological significance in terms of species richness, endemism, and unique evolutionary/ecological phenomenon.

Archaeological evidence indicates that people have lived in the region for at least 10,000 years. Human populations were very low in numbers and highly mobile until about

7,000 years ago. Various native peoples inhabited or used the CSNM area including the Shasta, the Klamath and Modoc tribes. Euro-American settlement in the Rogue and Shasta valleys from the 1850s on spurred the development of a new way of life in the region. Farmers and ranchers began to transform the land. Cattle and sheep ranching became a significant use in the CSNM during the latter half of the nineteenth century. Livestock grazing of cattle on an allotment basis continues today across the Monument with authorized active use of 4,148 animal unit months (AUMs).

Logging became more important in the CSNM after the development of transportation routes, such as the railroad in the 1880s. Large scale salvage logging, partial harvests, and selective logging began in the 1940s and continued through the 1980s with clear-cutting being the preferred harvest method. In the 1990s, timber harvest levels decreased in the area now designated as the CSNM although approximately 83 percent of the coniferous forest has a timber harvest history.

There are approximately 470 miles of road on approximately 85,173 acres of land across all ownerships associated with the CSNM. Of this total, the BLM controls approximately 251 miles of road that accesses the 52,947 acres Monument. These roads provide access for recreation, private property and management activities such as wildfire suppression.

The majority of the CSNM is in a moderate to high fire hazard as a result of past vegetation management and suppression activities. Fire has played an important role in influencing historical ecological processes and continues to be recognized as playing an important role in the development and maintenance of vegetative diversity in fire dependent ecosystems found throughout the CSNM. Prescribed fire is a tool which could be used to lower fire hazards and meet objectives for vegetative communities within the CSNM.

The 52,947 acres of federal land encompasing the Cascade-Siskiyou National Monument are managed by the BLM. These federal lands are managed by the Bureau of Land Management's Medford District Office. Although there are approximately 32,222 acres of non-federal lands interspersed among the federal land within the Presidential Proclamation boundary, the Cascade-Siskiyou National Monument is comprised of only federal land.

Monitoring Plan Strategy

This document contains monitoring projects relating directly to livestock, a subset of all the monitoring projects presented in Appendix LL of the Draft Cascade-Siskiyou National Monument Management Resource Management Plan/Draft Environmental Impact Statement (see map 46 for a summary of all current and historical monitoring sites).

Individual monitoring projects will have clearly stated objectives and hypotheses with supportive predictors/standards. Methods of analysis used to examine predictors/standards supporting alternative hypotheses will be transparent and repeatable, relying as little as possible on anecdotal information, and subject to peer review.

The effects of livestock grazing and associated activities on individual species, populations, communities, and the richness of plant and wildlife habitat in the context of ecosystem functioning across the landscape is complex and some functions may not

be easily evaluated over a period of a few years. This monitoring plan seeks guidance from existing documents as well as the Presidential Proclamation of the CSNM to ensure an adequate monitoring program.

Several documents have been used to direct surveys, monitoring, and research:

1) The Presidential Proclamation (Appendix A);
2) Aquatic Conservation Strategy as adopted for the Monument (MACS - see Appendix BB);
3) The current Grazing EIS (USDI 1983a);
4) Standards for Rangeland Health and Guidelines for Livestock Grazing Management (USDI 1995, Appendix C);
5) Biological issues identified within Cascade Siskiyou Ecological Emphasis Area Draft
6) Environmental Impact Statement completed prior to the Proclamation of the Monument (USDI 2000).

The context for examining livestock impacts on biological elements of interest remains the allotment management plan(s) currently in place. Range managers strive to manage the landscape as effectively as possible within the constraints of current grazing EIS (USDI 1983a) and allotment agreements. Current grazing management practices will only change if detrimental impacts of livestock on important biological elements and their habitats are identified.

The monitoring projects presented in this document represent a subset of all the monitoring projects within the CSNM. The Cascade-Siskiyou National Monument Draft Resource Management Plan/Draft Environmental Impact Statement presents an overall monitoring strategy including projects not directly related to livestock grazing and associated activities.

This document fulfills several general goals:

- the data provided by the individual monitoring projects will fulfill the requirements for completing upcoming livestock allotment assessments;
- examine whether current management strategies fit the landscape in terms of the maintenance of important natural resources (implementation monitoring);
- determine if management plan is effective in meeting its objectives (effectiveness monitoring;
- and monitor specific biological objects and ecological context regarding livestock use.

II. IMPLEMENTATION, EFFECTIVNESS, AND VALIDATION MONITORING

The CSNM Resource Management Plan (USDI 2001) directs monitoring on public lands: "Monitoring is an essential component of natural resource management because it provides information on changes in resource use, condition, processes, and trends. Monitoring also provides information on the effectiveness of management activities and strategies. The implementation of this plan will be monitored to ensure that management actions follow prescribed management direction (implementation monitoring), meet desired objectives (effectiveness monitoring), and are based on accurate assumptions (validation monitoring). Some effectiveness monitoring and most validation monitoring will be accomplished by formal research."

In the context of grazing within the Monument, implementation monitoring examines whether criteria for grazing strategy (e.g. timing and intensity of grazing), location of

livestock handling facilities, the adherence of MACS and other objectives are being implemented.

Research Objectives Fulfilling the Role of Implementation Monitoring

- Determine if the spring/summer and other grazing management strategies suit generalized landscape of the diverse allotments and pastures of the Monument.
- Determine if any livestock handling features occur within riparian systems.
- Determine if currently unmonitored and isolated springs, seeps and wetlands meet the definition of riparian communities ordained by the MACS.
- Determine if surveys are required to determine if conditions of isolated springs, seeps and wetlands meet MACS objectives.
- Determine if surveys for listed species (RMP) have been completed.
- Determine if the basic assumptions of conventional range management concerning pasture homogeneity, livestock distribution, and plant community successional changes are valid for the Monument landscape.
- Determine if the use of "Potential Natural Vegetation" is an adequate benchmark for assessing rangeland condition.

Research Objectives Fulfilling the Role of Effectiveness Monitoring

Many of the objectives pertinent to effectiveness monitoring are defined by the Cascade Siskiyou National Monument Draft Resource Management Plan (USDI 2000), MACS, Best Management Practices, Rangeland Standards and Guideline, the Grazing EIS (USDI 1983a) and the Federal Clean Water Act (as amended by the Water Quality Act of 1987). The following objectives are derived from the above documents:

- Determine if current livestock management maintains water quality associated with riparian plant communities [Federal Clean Water Act (as amended by the Water Quality Act of 1987)]
- Determine if the physical integrity (bank integrity, bottom integrity) of riparian plant community habitats are maintained under the current management regime (MACS - see Appendix BB).
- Determine if plant composition of the range of wetland plant communities (riparian along streambanks; isolated springs and wetlands) (MACS - see Appendix BB) within the Monument fall within a desired state.
- Determine if total plant cover, species composition, litter cover, bare ground, and erosion meet Rangeland Health Standards.
- Determine if soil and site conditions provide the opportunity for the establishment of desired plants.
- Determine if the management strategy provides periodic breaks from grazing for rangeland vegetation during critical growth periods to promote plant vigor, reproduction and productivity.
- Determine if important wildlife habitats/issues identified within the Grazing EIS (elk and deer range & interaction with livestock, maintenance of wetlands as important foraging and nesting habitat for grouse; maintenance of important waterfowl habitat in the proximity of Hyatt and Howard Prairie lakes) are maintained by the current management regime and meet Rangeland Health Standards.
- Develop local livestock grazing impact guidelines for proper use (Best Management Practices - Appendix AA).

Research Goals Fulfilling the Role of Validation Monitoring

The Presidential Proclamation calls for examining the impact of livestock on important biological elements of the Monument. This implies the use of validation monitoring with suitably defined treatments (that is, livestock impacted areas) and controls (no grazing) to assess current livestock impact on the biological elements listed in Table 1.

The first research goal is therefore to identify if livestock directly impact any of the biological elements listed in Table 1 so as to reduce their abundance, or ability to persist on the Monument landscape. Research objectives relating directly to the elements listed in Table 1 are addressed within the discussion of the livestock enclosure/exclosure project. The term exclosure and enclosure are used synonymously in this document depending upon the perspective of the subject matter (e.g., livestock cannot graze plants inside the exclosure and, conversely, plants inside the enclosure cannot be grazed by livestock). The data and interpretations will be pertinent to the site of the enclosure and paired site only, though surveys may be used to extend the results to the larger landscape.

Thus, the second goal is to determine the representability of livestock exclosures to the rest of the Monument using landscape-level surveys. Where possible, these surveys will be designed to also provide information allowing the achievement of effectiveness monitoring. These surveys are discussed in more detail in Section V "Projects providing context for the Livestock Enclosure Study."

Existing Data

Determining livestock impacts on biological elements of interest requires examining and critiquing existing data as well as designing new projects to fill data gaps. Existing projects include rangeland trend data collected at 7 locations within the Monument, utilization data collected within 12 plots/transects within the Monument, general maps of livestock utilization, transects examining browsing of shrubs, riparian photos, riparian transects, and an analysis of fecal composition to determine diets of livestock, deer, and elk. These data will be re-analyzed using a common set of statistical tools and interpreted in mutual context to each other and information from other projects completed over the next three to five years. The project descriptions at the end of this document provide more detail on existing data sets.

Summary of Perceived Data Gaps

Several projects are underway to examine plant community changes that have occurred over the past few decades. This data will serve as an important temporal backdrop for current rangeland condition surveys. Together with historical information on management changes over the last 100 years, understanding patterns of plant community change will help prioritize management issues in the future.

Vegetation maps derived from satellite imagery and field surveys will provide an understanding of the patterning of plant communities across the landscape, while also identifying areas for restoration.

Existing information, provides little understanding of the distribution and condition of springs, seeps, and wetlands within the Monument. Lack of range trend sites within wetland plant communities identifies a serious knowledge gap. Also missing is an understanding of livestock impacts on higher elevation semi-wet meadow and conifer understory plant communities.

Noxious weed surveys and preliminary plant community surveys indicate that weed invasion is a serious threat to local plant communities. Patterns of weed invasion across the landscape, factors facilitating weed invasion, and methods of weed eradication need to be studied to prevent further deterioration of plant communities.

Plant community trend monitoring needs to be extended to all plant communities across the landscape, particularly those impacted by livestock and located in parts of the landscape not currently monitored (north of Highway 66).

Perhaps the most serious problem with current monitoring is the lack of control areas (monitoring in livestock impact-free areas), to serve as a comparison to livestock impacted areas. Control areas in the form of livestock exclosures are needed to represent each general plant community within the CSNM. Additional exclosures are needed to examine particular issues (for example, weed invasion, or livestock impact to a rare plant and wildlife species). Temporary livestock exclosures may be used to augment replication around critical ecological issues in the shorter term.

Detailed site specific studies centered around livestock exclosures must be supported by landscape surveys to achieve a landscape perspective of direct impacts of livestock on important elements of the CSNM. The remainder of the document describes the intensive monitoring projects within exclosures and adjacent paired sites, and supporting monitoring/landscape surveys.

III. ENCLOSURE STUDIES OF LIVESTOCK IMPACT ON OBJECTS OF BIOLOGICAL INTEREST

The words exclosure and enclosure are used interchangeably dependent on whether livestock or the natural objects of interest are the subject of discussion. When referring to livestock and their exclusion from a study site, the word exclosure is used. The word enclosure is used in reference to biological elements enclosed by a fence. The biological elements examined in this document are listed in Table 1.

Table 1. Important Biological Elements of the CSNM forming part of the Livestock Enclosure Project.

No.	Biological Object	Management Action/Comment	Supporting Monitoring/Survey Projects
1a	Plant communities (grasslands, shrublands, woodlands, conifer understory, riparian, wetland)	The Presidential Proclamation requires the BLM to evaluate livestock impact across the full range of plant communities within the Monument.	All enclosures, existing range monitoring; landscape condition surveys; reexamination of historic vegetation plots
1b	Weeds (classified as noxious, and others)	Weeds have the ability to directly impact most of the values described within the Presidential Proclamation	Continuing surveys; pilot studies aimed at eradication; livestock enclosure study; permanent transects; trend data; landscape condition surveys; reexamination of historical data
2	Greene's Mariposa lily	Mariposa lily preserve created to protect from grazing	Continuing surveys; population monitoring

Table 1. Important Biological Elements of the CSNM forming part of the Livestock Enclosure Project.			
No.	Biological Object	Management Action/Comment	Supporting Monitoring/Survey Projects
3	Shrub and ground-nesting bird success	The literature identifies livestock do impact nesting success, monument sampling size may be too small to achieve statistical significance	Possible fence-line contrasts
4	Klamath Mardon Skipper	Only 3 meadows within the Monument are known to support populations of skipper	One meadow is almost entirely protected by a livestock enclosure; enclosure also serves as a control for remaining meadows
5	Rare aquatic snail habitat	Past surveys have identified several aquatic snail spring sites for study and protection	Landscape surveys, riparian studies

Rationale for Enclosure/Exclosure

Without exception, studies that have examined ungrazed areas along with adjacent grazed areas have shown that grazing has had major effects on the vegetation in the short- and/or long-term. These studies indicate that grazing is a major influence on the vegetation throughout the west. The enclosure study in the CSNM is designed to help determine how well the existing research on grazing impacts applies to the Monument.

Livestock impacts on biological elements of the Monument can only be assessed relative to areas of no livestock impact. Since the entire landscape has been grazed in the past, monitoring within newly created control areas (livestock exclosures) will be a measure of recovery, or response of plant communities/biological elements to the removal of current livestock impact. Control areas (exclosures) without livestock are also necessary to determine if changes in the abundance of variables of interest are due to livestock impact, or other extrinsic influences (climate change, fluctuation in amount and pattern of precipitation), or other unrecorded disturbance events. To fulfil the statistical and logical requirements for interspresion of treatments, livestock impacted areas and exclosures should be located adjacent to each other on the same ecological site.

Limitations of the Enclosure/Exclosure Project

A practical limitation of the enclosure studies relate to the number of replication. In general, this is common to landscape-level projects. In particular to the Monument, the wide range of biological elements potentially impacted by livestock mean that few replicates are associated with each element being examined.

Several project design features will be followed to alleviate the limitations of replication:

- Site specific sampling will continue until sample adequacy has been obtained;
- Landscape surveys of conditions represented by enclosure and paired area will be conducted simultaneously to determine the extent of the situation represented by the enclosure/exclosure and paired transects;
- Temporary exclosures will be erected to increase replication around critical issues;

- Full use is made of existing monitoring sites to integrate new monitoring endeavors with historical data.

For most variables, statistical inference is derived at the landscape level stratified by plant community, implying that each enclosure and paired site represent a single replicate. This does not allow statistical validation at the enclosure level itself unless sub-samples are used as a basis for analyses. This constitutes pseudo-replication. In the case of the plant cover data collected within the paired plots, subsets of the transect data will be used as individual replicates. These grazed and ungrazed pseudo-replicates are not interspersed, a requirement for most central tendency based statistical algorithms. Where these tests are used, data will be interpreted taking account of this bias. Alternatively, statistical corollaries using randomization techniques will be used (Manly 1991).

Landscape Location

A close examination of existing trend/plant composition plots indicated incomplete coverage of plant communities found across the landscape (Map 47). No current rangeland monitoring plots fall within springs, wetland, and rocky plant communities. Furthermore, only 1 utilization plot occurs north of State Highway 66. New monitoring sites will be placed to fill these data gaps. Exclosures are being constructed at principal locations to provide the necessary control to examine livestock impacts on a larger range of plant communities, as well as specific biological elements identified by the Presidential Proclamation for the CSNM.

Thirteen exclosures have been completed, most to protect/study rare biological elements mentioned in the Presidential Proclamation (Map 47). Of the exclosures remaining to be built, two exclosures will be located to study livestock impact on Greene's mariposa lily. Most of the remaining unbuilt exclosures will be located in close proximital to existing rangeland monitoring sites. These permanent exclosures are designed for longer-term monitoring extending beyond the initial three to five years of the livestock impact studies. To improve statistical inference of observations, additional temporary exclosures will be erected to increase replication of exclosures studying particular biological elements of interest across the landscape to improve statistical inference of observations.

Current Status of Enclosure/Exclosure Construction

Table 2 identifies exclosures already constructed and also projects the number of exclosures needed to adequately represent plant communities and rare elements within the Monument. Three additional exclosures will be constructed to determine the effects of livestock on annual grass/yellow starthistle persistence in the Highway 99 and Agate Flat area.

Time-line

Present livestock management plans will not be altered prior to the studies required by the Presidential Proclamation. This monitoring plan calls for intense monitoring for an initial 3 to 5 years. The completed livestock exclosures and database will provide a framework for less intensive but sustained monitoring of biological elements and ecological issues in the longer-term existence of the CSNM.

Table 2. Cascade-Siskiyou National Monument Enclosures.			
General Location	Plant Communities	Comments	No. excl.
Exclosures already completed (13) as of Jan. 2001			
Howard Prairie	riparian, conifer understory		1
Chinquapin Mtn	wet meadow/spring/semi-wet meadow		1
Chinquapin Mtn	wet meadow/spring		1
Chinquapin Mtn	spring	protect *Fluminicula* #17	1
Chinquapin Mtn	dry meadow		1
Oregon Gulch	wet meadow, riparian		1
Hobart Peak	dry meadow/spring	Mardon skipper habitat	1
Hobart Peak	Conifer understory		1
Hobart Peak	dry meadow, conifer understory	existing range trend site	1
Soda Mountain	rocky meadow		1
Soda Mountain	semi-wet meadow	restoration site	1
Boccard Point	semi-wet meadow	restoration site	1
Beane cabin	conifer understory		1
Exclosures located & surveyed for rare plant and cultural resources (2)			
Parsnips lakes	wet meadow	also site of rare sedge	1
Highway 99	oak woodland, Mariposa lily study site	rebuild existing enclosure	1
Exclosures yet to be located & surveyed for rare plants and cultural resources (9)			
Agate Flat	oak woodland	study the effects of cattle on Mariposa lily persistence	1
Agate Flat	pair enclosures with existing trend sites		5
Agate Flat	open grasslands	study livestock weed interaction	3
Total projected number of enclosures (24)			

IV. MONITORING WITHIN LIVESTOCK EXCLOSURES

This section of the monitoring plan is comprised of 5 individual studies examining variables associated with individual plant, wildlife, plant community composition and structure, and physical environment within livestock exclosures and paired sites.

1a and 1b. Plant Community change following livestock removal: Grasslands, Shrublands, Woodlands, Conifer Understory, Riparian, Wetlands

Introduction

This project examines plant community change following livestock exclusion to determine if plant communities within exclosures change towards a more desired condition relative to current vegetation composition and structure. Public comment and scientific opinion have frequently differed regarding the effects of livestock on the range of structural, compositional, and environmental factors pertinent to plant communities of the CSNM. A literature survey of plant community changes associated with livestock exclosures will identify the range of changes expected within the exclosures constructed within the Monument.

Case Studies of Long-Term Vegetation Dynamics - upland communities

Anderson and Holte (1981) reported a doubling in the cover of shrubs and perennial grasses after 25 years of rest from livestock grazing at Idaho National Engineering Laboratory (INEL). The 20-fold increase in grasses is thought not to be at the expense of shrubs but related to increased seed reserves with the development of the perennial grass plants. The authors described a stage of slow recovery (the initial 10 years) followed by more rapid recovery related to seed reserves. No obvious seral stages could be defined. The study showed high variance between plots. Anderson and Inouye (1988) discussed the establishment of dense stands of non-native cheatgrass (*Bromus tectorum*) since monitoring the initial presence of non-native cheatgrass (*Bromus tectorum*) at the INEL sites in 1975. The authors noted that establishment occurred in the absence of fire and grazing and during a period of higher than average rainfall (1966-1975). A subsequent decrease during drier years implied a dependence on rainfall.

Burning of the good condition plots, including perennial grasses, resulted in an increase in palatable grasses, in spite of an initial large increase in cheatgrass. The exclusion of cattle during the recovery period after burning is thought to be crucial (West and Hassan 1985, Hassan and West 1986). This observation of interaction between disturbances (or cumulative nature of fire and livestock disturbance) can be explained in terms of thresholds of disturbance.

Yorks et al. (1992) reported on the repetition of a 63-year-old transect covering several vegetation types, including sagebrush-dominated communities in Pine Valley, Utah. Many factors, including a moderation in livestock grazing, could be responsible for the substantial increases in canopy cover observed for several perennial grasses. This trend was less noticeable with sagebrush and attributed to a filling out of individual plants rather than increased numbers. The proportion of understory cover relative to total plant cover also showed an increase.

West et al. (1984) found that shrub-dominated communities (sagebrush semidesert) in 5 large paddocks in west central Utah did not show significant increases in perennial grasses following 13 years of rest under favorable precipitation conditions. The presence of annual grasses increased the possibility of community deflection towards cheatgrass domination.

Eckert and Spencer (1986) examined changes in shrub canopy cover, basal cover of herbaceous species, and frequency of occurrence of all species at 2 sites in northern Nevada. Both sites were managed under a 3-pasture rest rotation grazing system. One site showed no long-term change in frequency of species. The other site showed increased shrub cover and decreased palatable grass (*Stipa thurberiana* and *Agropyron spicatum*) cover over the 10 years examined. At one of the above sites, Eckert and Spencer (1987) found heavy periodic grazing to be the major cause for restriction of basal area growth and reproduction of palatable grass species over a 9-year study period.

Various Enclosure Studies - upland communities

Peters et al. (1993) commented on vegetation changes in 2 exclosures near Burley and Castleford (Idaho) over 50+ years following crop-land abandonment. Using frequency of occurrence data, the authors showed that 1 site showed change toward late-seral perennial grass species (*Agropyron riparium* and *Poa secunda*) while the other site remained dominated by annuals and biennials.

Rose and Miller (1993) reported on inside versus outside differences of 13 livestock exclosures 66 years after establishment using cover and density data. No statistically significant differences in cover between grazed pastures and exclosures were found for shrubs, although *Artenisia tridentata* showed increased density outside the exclosure. Total grass cover and density of all perennial bunchgrasses, except *Poa sandbergii*, were higher inside the exclosure. Forbs appeared to have a slightly higher cover and density within the exclosures, although these changes appeared to be species-specific.

Robertson (1971) examined an eroded and grazed 20-acre tract 30 years after the initiation of rest. The plant community showed increased cover by all its life-forms and re-establishment by *Agropyron spicatum*. The highest recovery was exhibited by thurber needlegrass (a 7-fold increase). The only decreases were shown by annual forbs and locoweed.

Tueller and Tower (1979) emphasized the negative aspects of exclosures – the stagnation effect arising from non-use of plants. As an example, they presented data showing an average 70% decline in the production of bitterbrush 10 years after fencing.

Pearson (1965) showed that aboveground production for sagebrush and several major bunchgrasses increased after 11 years of rest, in comparison to a site that had been grazed continuously for 70 years. An exception was *Phlox caespitosa*. This trend did not extend to below-ground production. The area being rested showed only 68% of the belowground root mass of the grazed area.

Sanders and Voth (1983) found greater ground cover on grazed plots versus protected plots in the Boise National Forest after 46 years of periodic data collection. No clear trends could be found on a species basis.

Holecheck and Stevenson (1983) found that 22 years of rest from grazing in northwestern New Mexico had little influence on plant composition at either of 2

sagebrush semidesert sites studied. Forbs had been eliminated from the study site prior to construction of the exclosures by heavy sheep grazing.

Potter and Krenetsky (1967) showed a decrease in ground cover by both grass and forbs in protected and grazed plots occupied by sagebrush semidesert in northwestern New Mexico.

Daddy et al. (1988) examined 3 sites with different grazing histories in northwestern New Mexico. Major phytomass contributors at the heavily grazed site were *Aristida sp.* and *Bromus tectorum. Brotclova gracilis* and *Hilaria jamesii* were more productive on grazed sites. The moderately grazed site had twice the herbaceous aboveground phytomass of the protected site.

Sneva et al. (1984) examined 10 exclosures established in eastern Oregon during the drought years of the 1930s in big and low sagebrush-dominated vegetation. Frequency estimates were evaluated in 1937, 1960, and 1974. Frequency of all native grasses (*Agropyron spicatum, Festuca idahoensis, Sitanion hystrix, Stipa thurberiana, Poa sandbergii*) was shown to increase or remain stable both within and outside the exclosures with one exception. *Poa sandbergii* decreased in 1 exclosure located in low sagebrush-dominated vegetation. Several factors confounded the results: the switch from spring sheep to spring-through-fall cattle-grazing, higher precipitation following 1937, a decline in overall livestock grazing intensity, and the effects of the sagebrush defoliator moth during the early 1960s.

McLean and Tisdale (1972) noted dramatic changes in the range of plant communities within a set of exclosures located in southern British Columbia.

Fescue Grassland Zone (McLean and Tisdale 1972): "Twenty nine years after fencing, there was five times the foliage cover of bluebunch wheatgrass, (*Agropyron spicatum*), Rough fescue, and Kentucky bluegrass (*Poa pratensis*) inside the enclosure as compared with that outside. There was also a marked decrease in the amount of Sandberg bluegrass, low pussy toes, and dwarf fleabane." "The average herbage production during the period 1959 to 1966 showed a 98% greater yield inside the enclosure compared with outside."

Fescue Grassland Zone (McLean and Tisdale 1972): "Twenty-nine years after fencing, there was a much greater cover of rough fescue, bluebunch wheatgrass, and junegrass inside the enclosure, compared to an abundance of dwarf fleabane and Sandberg bluegrass outside. A review of earlier observations suggests that vegetation on the grazed area had not changed appreciably." "The 4-year average herbage yield shows 73% greater production inside the fence [no grazing] as compared with outside [grazed area] following 32 years of protection".
Text in brackets [ ] added for clarity.

Fescue Grassland Zone (McLean and Tisdale 1972): "Observations made in 1940 and 1950 suggest that considerable improvement took place in the first 10 years after fencing. There was a marked increase in bluebunch wheatgrass and decrease in sandberg bluegrass. Between 1950 and 1959, there was a striking increase in the proportion of rough fescue present. The data support these observations, for 21 years after fencing the foliage cover of rough fescue was 10 times greater inside the enclosure than in the grazed area."

Ponderosa Pine Zone (McLean and Tisdale 1972): "Ten years after fencing, there was a considerably more bluebunch wheatgrass and rough fescue inside the enclosure as

compared with the grazed area and much less low pussy toes and Sandberg bluegrass. By the end of the next 9 years, there was still greater increase in the amount of bluebunch wheatgrass and rough fescue inside the enclosure and a marked decrease in Sandberg bluegrass, needleandthread, and low pussy toes." "Average herbage production indicated a 60% greater yield inside the enclosure as compared with that outside 15 years after fencing".

Ponderosa Pine Zone (McLean and Tisdale 1972): "Data recorded in 1959, 23 years after fencing, show that bluebunch wheatgrass plants inside the enclosure had over four times the foliage cover of those plants outside. Sandberg bluegrass on the other hand had much greater coverage on the outside as compared with inside. The poorer range condition outside was also reflected in the greater frequency of low pussy toes. In the 9 years following 1959 there was a marked increase in bluebunch wheatgrass both inside and outside the enclosure, and increase in pasture sage inside and a decrease in low pussy toes." "The average herbage yield indicated a 160% increase in production inside the enclosure over that outside after 23 years of protection."

Ponderosa Pine Zone (McLean and Tisdale 1972): "General observations and limited quadrat data obtained in 1949 and 1959 suggest that the greatest improvement took place in the 13 years following 1936, and continued to a lesser extent over the next ten years. During the initial period there was a marked increase in bluebunch wheatgrass. There was also a decrease in needleandthread, low pussy toes, and rabbitbrush." "The average herbage yield indicates a 124% increase in production inside the enclosure as compared with outside."

Ponderosa Pine Zone (McLean and Tisdale 1972): "Records taken in 1960 (23 years after fencing) indicate more bluebunch wheatgrass and silky lupine inside the enclosure as compared with the grazed area. There was also less western needlegrass (*Stipa occidentalis*), low pussy toes, shaggy fleabane, sixweeks fescue, and cheatgrass inside the enclosure. Ten years later the bluebunch wheatgrass had decreased and cheatgrass increased inside the enclosure because of gopher activity. Ground disturbance by gophers was greater inside the enclosure presumably as a result of protective cover for the rodents provided by old plant growth."

In studies under Ponderosa pine forests of northern Arizona, Arnold (1950) noted grazing related shifts away from native bunchgrasses and towards weeds and undesirable annual grasses. The authors noted the following:

"Under protection from grazing the taller bunchgrass species dominated the herbaceous composition within the five exclosures. The species that escaped or withstood a high degree of repeated grazing [outside the exclosures] were less abundant [inside the exclosures]."

"...the bunchgrass were highly sensitive to grazing, particularly under the lighter [tree] canopy [closure] classes where grazing was intense."

"By repeated removal of the tall stems and leaves [by livestock] the bunchgrasses on the grazed areas were reduced to a small part of the total herbaceous cover. This result contrasts sharply with those obtained from the ungrazed exclosures, where bunchgrass species dominated the herbaceous composition." Text in brackets [ ] added for clarity.

Chronosequence Approaches - upland communities

Tueller and Platou (1981) determined a successional gradient in northern Nevada by examining plant community changes moving away from a watering point. The observed pattern was determined to be different from theoretical pathways. *Agropyron*

spicatum was found to vary greatly between plots but was greatly reduced in the 2 plots closest to the watering points. *Bromus tectorum* cover was found to be highest closest to the watering points, while *Lupinus caudatus* and *Phlox longifolia* showed the opposite trend. *Poa secunda* generally showed a lack of trend. Cover values seem to correspond well with density data. *Sitanion hystrix* showed relatively high densities in low and high seral stage plots. Sagebrush density appears to vary considerably, being highest in the third and last plots, thus not yielding a clear pattern. In general, vegetation cover increased with decreasing condition, while litter cover and microphytic cover was highest in the plots furthest away from the water.

An examination of ten piospheres on the Snake river plains of Idaho yielded different results (Hosten 1995). While species level trends were apparent within individual piospheres, species trends were not replicated at the landscape level. This may be due to the diversity of environmental factors at larger spatial scales. Across the landscape, the least impacted transects (furthest from the watering points) were most similar to nearby relict (ungrazed) areas. The data stress the importance of basing management on site-specific plant community monitoring.

Studies of bitterbrush habitat types in north central Washington also suggest that moderately livestock impacted communities were more similar to reference communities than heavily impacted sites (Youtie et al 1988). As with sagebrush steppe communities, areas of intense livestock impact showed higher shrub cover and lower bunchgrass cover (Youtie 1988, Hosten 1995). General landscape-level patterns of community change may be obscured by the interaction of other ecological processes such as fire.

Many of the above upland studies were conducted in the Great Basin, however, a generalized model of plant community dynamics within an oak woodland environment supports some of the common plant community changes identified in the above literature, especially regards annual and perennial grass dynamics. George et al. (1992) associates annualization of grasslands in an oak woodland environment with poor livestock management and identifies the difficulty of restoring "Mediterranean" grasslands back to native perennial domination [see the weed management plan and literature review in Appendix GG of the CSNM DRMP (USDI 2001)].

Riparian Communities

The importance of riparian zone habitat to the maintenance of biological diversity at the landscape and local scales cannot be over emphasized. Riparian zones are one of the most limited, (Elmore 1987) and most sensitive (Kaufman and Krueger 1984) habitats in the western landscape. Riparian zones are the most productive and diverse habitats in much of the west (Thomas et al. 1979) and frequently produce 10 times the forage of adjacent upland forested sites (Elmore1987).

The link between riparian vegetation diversity, especially in the shrub and overstory layers, and riparian wildlife diversity is well documented (Kauffman and Krueger 1984, Taylor 1986, Szaro et al. 1985). Wildlife populations adjacent to riparian zones are affected by habitat conditions and resultant wildlife populations in the riparian zones (Kauffman and Krueger 1984). Health riparian habitat also usually supports species not found in the uplands and thus contributes to species diversity at larger landscape scales.

Plant compositional and structural changes in riparian communities are better understood. Poor livestock management can result in the loss of woody and herbaceous species critical for stabilizing streambanks.

In a study comparing riparian vegetation between grazed areas and ungrazed exclosures northwest of Fort Collins (Colorado), Schultz and Leininger (1990) found significant differences in vegetation structure and composition. Total vascular vegetation and the abundance of shrubs and grasses were greater in livestock excluded areas, while forbs showed similar abundance to grazed areas. Livestock excluded areas showed higher litter and lower bare ground.

The recovery of woody riparian appears to occur rapidly following livestock exclusion. In south central Washington, Rickard and Cushing (1980) show the re-establishment of willow (Salix amygdaloides) in streamside riparian areas within 10 years of livestock exclusion.

Monitoring projects supporting the enclosure studies are aimed at identifying the range in plant compositions and livestock impacts of riparian communities across the landscape (Projects I, J, and K). In addition to the transects described in this section, greenline transects assessing vegetation at the waters edge will also be conducted within and outside of all riparian exclosures and other selected stream reaches within the Monument.

By virtue of their limited range and disproportionate impact by livestock, seeps, springs, and wetlands require special management. Key issues, management objectives, and variables to be monitored are identified by documents such as the MACS (Appendix BB), Grazing EIS (USDI 1983a), and the Best Management Practices (Appendix AA).

Important variables include:

- surface disturbance
- deep soil disturbance
- post-holing
- bank integrity
- bottom integrity
- species richness
- presence and abundance of palatable woody species; and
- plant community composition.

While monitoring variables associated with the above ecological issues are straight forward, determining whether measured livestock impacts detrimentally effect ecosystem functioning is more difficult. Local thresholds of disturbance will be generated by examining patterns of species richness, weed abundance, and vegetation structure associated with seeps, springs and wetlands surveyed across the larger Monument landscape (Project K). Measured levels of disturbance (percent area surface disturbed, percent area with post holes, and percent area showing deep disturbance) associated with maximum native species richness may be adopted as the maximum level of acceptable disturbance. The enclosure and other projects will also examine whether management and literature-based recommendations for post-grazing stubble height and percent utilization are attained. This approach is dependent on landscape surveys which are dove-tailed to this enclosure study.

Surveys will be conducted prior to livestock turnout to determine pre-treatment similarity for all of the above variables. Differences between enclosure and paired livestock impacted site will be assessed following the grazing season.

Monitoring projects supporting the enclosure studies are aimed at identifying the range in plant compositions and livestock impacts of riparian communities across the landscape (Projects I, J, and K). In addition to the transects described in this section, greenline transects assessing vegetation at the waters edge will also be conducted within

and outside of all riparian exclosures and other selected stream reaches within the Monument.

Issues: Management Objectives

Results from the literature suggest that observable short-term (less than 3-4 years) differences between exclosures and paired grazed sites may be restricted to fluctuations of annuals, vegetation structure, and soil disturbance.

The following ecological issues and associated management objectives will be examined using the data collected within the exclosures and paired livestock impacted sites:

- plant community composition: increase relative cover by native species;
- key species age/maturity/condition class distribution: maintain a distribution of age/maturity/condition classes for key species;
- weed invasion/abundance: minimize new points of weed invasion; maintain a favorable balance between native perennial herbaceous plant species and introduced weeds;
- vegetation structure: maintain/improve vegetation structure (sward height and the balance of life-forms (herbaceous, shrub, and tree strata) as a basis for improving wildlife habitat; species richness: maximize species richness by native species;
- species richness: maximize species richness by native species;
- species diversity (an interaction of species richness and relative abundance): maximize; species diversity (increase cover by rare species at the cost of non-native weeds and common native species);
- soil cover: minimize bare soil consequent to displacement of perennial vegetation due to livestock impact; minimize thatch/litter buildup by medusahead.

Objectives

Objective 1: Determine if the current range management regime results in differences in plant community composition between livestock exclosures and paired sites. (HA = alternative hypotheses).

HA1.1: There are no significant differences in plant composition between paired livestock exclosures and impacted sites (Predictions: Ordinations show interspersion of livestock impacted and paired enclosure sites; Plant community classification procedures maintain livestock impacted and paired non-impacted sites within the same classes).

HA1.2: There are significant differences in plant composition between paired livestock exclosures and impacted sites (Predictions: Ordinations show lack of interspersion of livestock impacted and paired enclosure sites; Plant community classification procedures maintain livestock impacted and paired non-impacted sites within different classes).

Objective 2: Determine if the current range management regime results in differences in key species (native bunchgrasses) abundance between livestock exclosures and paired sites.

HA2.1: There are no significant differences in the abundance of key species between paired sites (Prediction: Chi-squared analysis, t-tests, and repeated measures Analysis of Variance (ANOVA) show no significant difference in canopy cover, 5% at p=0.10).

HA2.2: Livestock impact results in a significantly higher abundance of key species immediately prior to livestock release in the years following enclosure construction (Prediction: Chi-squared analysis, t-tests, and repeated measures ANOVA show significant difference, at least 5% canopy cover at p=0.10).

HA2.3: Livestock impact results in a significantly lower abundance of key species immediately prior to livestock release in the years following enclosure construction (Prediction: Chi-squared analysis, t-tests, and repeated measures ANOVA show significant difference, at least 5% canopy cover at p=0.10).

Objective 3: Determine if the current range management regime impacts weed species abundance relative to livestock enclosure areas.

HA3.1: There are no significant differences in the abundance of weed species between exclosures and paired sites in the years following enclosure construction (Prediction: Chi-squared analysis and repeated measures ANOVA show no significant difference in weed canopy cover).

HA3.2: Livestock impact results in a significantly higher abundance of weed species in livestock impacted sites compared to exclosures immediately prior to livestock release in the years following enclosure construction (Prediction: Chi-squared analysis and repeated measures ANOVA show significant difference, at least 5% canopy cover at p=0.10).

HA3.3: Livestock impact results in a significantly higher abundance of weed species in livestock impacted sites compared to exclosures immediately prior to livestock release in the years following enclosure construction (Prediction: Chi-squared analysis and repeated measures ANOVA show significant difference, at least 5% canopy cover at p=0.10).

Objective 4: Determine if the current range management regime facilitates a higher species richness than livestock exclusion.

HA4.1: There is no significant differences in native plant species richness between livestock exclosures and paired livestock impacted sites in the years following enclosure construction (Prediction: Chi-squared analysis shows no significant difference).

HA4.2: There is a significant improvement in native plant species richness between livestock exclosures relative to paired livestock impacted sites in the years following enclosure construction (Prediction: Chi-squared analysis shows significant difference).

HA4.3: There is significant reduction in native plant species richness between livestock exclosures and paired livestock impacted sites in the years following enclosure construction (Prediction: Chi-squared analysis shows significant difference).

Objective 5: Determine if the current range management regime within springs, seeps, and wetlands increases or decreases soil surface and deeper soil disturbances relative to ungrazed controls.

HA5.1: There are no significant differences in soil surface disturbance and deeper soil disturbance between livestock exclosures and paired sites (Prediction: Chi-squared analysis and repeated measures ANOVA show no significant difference).

HA5.2: There is significantly less soil surface and deeper soil disturbance in livestock exclosures than paired sites (Prediction: Chi-squared analysis and repeated measures ANOVA show significant difference).

Methods and Materials

Plant community, soil surface disturbance, and vegetation structural data will be collected in all exclosures and paired sites. Individual plant species cover, soil surface cover, and soil surface disturbance will be assessed using a recognized BLM vegetation monitoring methodology (Interagency Technical Reference 1996). A gimballed point technique (Winkworth and Goodall 1962) will be used to measure plant species point cover for the range of vegetation strata (tree, shrub, and herbaceous) within the exclosures and paired plots. The technique is very similar to that employed by the Nature Conservancy (Sawyer and Keeler-Wolf 1995), and data sheets will meet the requirements of both handbooks. The utility of a sighting device (gimballed point sighting tube) instead of a suspended rod improves accuracy of recordings (Interagency Technical Reference 1996).

Transects will be divided into at least 4 pseudo-replicates of 20 points spanning the sampling area. The total number of pseudo-replicates will be dependent on the sampling rate necessary to achieve sampling adequacy (see analyses). Initial pseudo-replicates will be permanently marked to allow repetition during subsequent data collection events.

All forms of vegetation and soil cover data need to be collected twice during a sampling season. During the first year of sampling, data needs to be collected prior to livestock turnout. This is necessary to measure the initial similarity of enclosure and paired sites prior to livestock turnout. Measurement of the same variables at the end of the grazing season will quantify livestock impact on plant structural attributes and the physical environment defined by the percent bare soil and surface disturbance. Differences in individual species abundance and plant community composition can only be assessed during subsequent years, following at least one year of rest within exclosures, and continued grazing within the paired site. These differences need to be based on data collected prior to livestock turnout, so as not to be biased by the current years grazing. An important adjunct to the above-defined cover readings are the photos to be taken at the same time. Permanently installed fenceposts will identify the site of origin of the photos, as well as define the direction and angle of sighting. Photos will be taken at the same time of day to minimize confoundment by different patterns of shadow attributed to changes in the angle of insolation.

In addition to the transects described in this section, Project K is aimed at identifying the range in plant compositions and livestock impacts of riparian communities across the landscape.

Analyses

Sample adequacy

Several methods are used to assess adequacy. For cover data collected using a point cover intercept technique, the Interagency Technical Reference (1996) recommends plotting running average and standarddeviation for a range of sample sizes bracketing the likely desired sampling rate.

Individual variable (species, growth form, or soil cover attribute)

Pretreatment data will be collected to determine similarity of plots before the advent of the grazing season. Paired plots will be deemed suitable if analysis of pre-treatment data shows no significant difference between enclosure and paired transect.

Following guidance by the Interagency Technical Reference (1996), analysis will consist of a Chi Square contingency table analysis to test for significant change in numbers of "hits" on key species, other plant species, or cover classes between years, or between paired transects. Data will also be expressed and presented graphically as percentage cover. Repeated measures Analysis of Variance (ANOVA) will be used to examine statistical difference between grazed and ungrazed pseudo-replicates at the individual enclosure and paired plot level.

Plant community analysis

Standard multi-variate statistical procedures will be used to identify plant communities and plant community dynamics from the original field data collected by field technicians. These statistical procedures are commonly referred to as "dimension reduction" techniques (Kent and Coker 1992). Several procedures will be employed to assure an unbiased examination of data. All multi-variate techniques used are based on an examination of a plot by plot similarity matrix constructed using a similarity index. Indices bias the relative importance of rare or common species within the similarity matrix depending on the formulation of the index. For this reason, indices favoring either perspective (rare or common species) will be used to assure unbiased interpretation of results.

Classification is a multi-variate technique that seeks natural groupings of objects (in this case, stands or sampling locations) within multi-variate hyperspace. Stands (transects) within classes are more similar to each other than stands representative of different classes. Hierarchical classification will be used to gain an understanding of the structure of the plant composition data. This will allow the choice of plant community classes at a suitable level of similarity as defined by similarity index chosen for the classification exercise. Groupings derived from the classification procedures should reflect patterns observed within ordination scatter diagrams. For pre-treatment data, paired transects should fall within the same classes prior to livestock impact. Paired transects separated into different classes in years following enclosure construction and the completion of at least one year of livestock impact are indicative of divergent plant community development under rest and continued grazing.

Ordination summarizes data from n-dimensions (each plant species being a dimension) to just two or three dimensions. The proximity of objects (in this case, individual transects representing livestock enclosure and paired transect) within ordination space is a representation of similarity between transects. Patterns between sets of objects in ordination space represent patterns in the original field data. Such summarization of data may also result in loss of information, hence these techniques are termed exploratory. Adequacy of fit of objects within a scattergram in ordination space is measured by a "stress" indicator. Additional multi-variate techniques will be employed to validate observations where "stress" is above the acceptable level. Increased distance between paired sites after successive years of grazing would indicate that livestock are impacting plant communities for the sites examined.

Network analysis focuses on object-to-object relationships, a very different perspective than the "data-wide" patterns detected using ordination techniques. The algorithm produces minimum spanning trees, relating objects monotonically and using association values from the association matrix for the data set being examined. These diagrams can be used to check the relative positions of objects within ordination diagrams.

The collection of paired monitoring sites falling within grasslands, shrublands, and woodlands may offer the opportunity of using Multi-variate Analysis of Variance (MANOVA) suitable for time series analysis based on difference in canopy cover for all species within the paired plots.

In general, since plant community changes reflect individual species changes all analyses will be used in a mutually supportive manner.

2. Green's Mariposa Lily (*Calochortus greenei*) Monitoring

Introduction

This rare lily is another local endemic plant. Most of the known populations for this species occur within the Monument and south into Siskiyou County, California. Several past formal and informal monitoring studies have been completed, including Knight (1992) and by Brock (1988). A 'Mariposa preserve" was established in a large populations in the west Colestine site west of the Interstate 5. In 1996, a conservation strategy for the Medford BLM drafted by Richard Brock identified the need for formal monitoring of this species to a) monitor trends and b) more fully understand its biology and autecology, especially in response to herbivory and livestock grazing.

This species occurs in open sites in grasslands, chaparral and oak woodland/savannah communities, usually on gentle slopes (< 30%), most often on south and west aspects in heavy clay soils. Herbivory from deer, rabbits, and livestock, habitat conversion from noxious weeds, and tree and shrub encroachment (succession) have all been identified as threats to this species. This species, like other lilies, is relatively longed lived (50+ years). Individuals can go dormant and in any given year not appear above ground. Long-term studies of this species will be necessary to understand population dynamics.

Objectives

Objective 1: Develop a better understanding of the life and reproduction cycle, and gain an insight into life history, physiology, and population biology.

Objective 2: Monitor populations to measure demographics, trends, and analyze any affects from herbivory, grazing, and successional changes.

Objective 3: Identify significant changes in the numbers of *Calochortus greenei* plants within livestock impacted areas versus paired exclosures.

HA 3.1: There are no significant differences in counts of *Calochortus greenei* plants inside versus outside the livestock exclosures [Prediction: chi-squared analysis show counts of *Calochortus greenei* within livestock impacted sites not to be more than 10% below livestock enclosure numbers (p=0.10)].

HA 3.2: Counts of *Calochortus greenei* are significantly lower within livestock impacted sites relative to paired livestock exclosures [Prediction: chi-squared analysis show counts of *Calochortus greenei* within livestock impacted sites to be more than 10% below livestock enclosure numbers (p=0.10)].

Methods and Materials

Formal Monitoring

Formal replicated permanent monitoring plots will be established in select locations in the monument. The 5 target sites are:

Colestine west (Mariposa Preserve)
Colestine east (corral)
Pilot Rock
Oregon Gulch RNA
Agate Flat

Formal monitoring at each site will follow a modified protocol outlined in the 1996 Medford Draft Conservation Strategy for *Calochortus greenei*. At every location, 3 – 5 meter by ½ meter transects will be established subjectively, so that at a minimum 20 flowering plants are present within each plot. The length of the plots may have to be longer (i.e. 10 meters) to capture enough plants; this will be evaluated at the site. Aluminum tags attached to steel pegs, driven into the ground 3 – 5 cm from the base of the plant on the north side, will serve to track each plant. Plants growing closer than 5 cm will be considered a single genet. Plots are visited 3 times during the growing season: Once in early spring (April/May) to document seedlings and young plants; (2) in early July to document flowering; and (3), a final visit in August would document fruiting success. These transects will be examined annually for 3 years during the Grazing study, and then in year 5 (2005), year 7 (2007), and in year 9 (2009). At the conclusion of the monitoring, a determination will be made to continue monitoring or not. The following elements will be measured and collected by each 1 x ½ meter micro-plots:

1. Presence or Absence (counts) by age class (seedlings/juveniles, non-reproductive adult, reproductive adult)
2. Maximum basal leaf width
3. Frequency and cause of herbivory and estimate of the amount of leaf area lost
4. Number of buds/flowers/fruits
5. Percent cover by associated species
   Within the East Colestine, Pilot Rock, and Agate Flat sites, plots will be paired with livestock exclosures. Information on plants within the 3 enclosure plots will be compared with the plots outside.

Informal Monitoring

For each of the populations formally monitored, a 100% census will also be done every year using the standard BLM Rare Plant sighting form. At these sites, smaller satellite populations have been documented in close proximity, outside the formal monitoring areas. Other documented sites occur near Hutton Creek, Keene Ridge, Skookum and Salt Creek, along Jenny Creek and elsewhere. At a minimum, 10% of these sites will be revisited each year such that in ten years, all documented sites will have been revisited at least once. The sighting report information will be stored in the Medford Rare Plant database. Empirical comparisons with previous observations can be made to show general status and trends for *Calochortus greenei* throughout the Monument.

Surveys

Additional surveys in the western and southwestern portion of the monument need to occur. Few formal surveys have been documented, although some undocumented surveys have occurred in the immediate area around known sites. Landscape surveys

for Gentner's fritillaria will search similar habitat and will be likely to document new locations. Additional surveys for *Calochortus greenei* are encouraged in other areas in the Monument.

Analyses

Information collected from the formal monitoring and the paired plots will be analyzed by using paired t-tests or repeated measures ANOVA. Demographic data will be used to develop life cycle matrices and population estimates for different age classes. These estimates are necessary to understand Green's Mariposa viability and persistence on the landscape.

3. Shrub and Ground-nesting Bird Density and Nesting Inside vs. Outside Livestock Exclosures

Introduction

Numerous studied have shown that livestock grazing can impact shrub and ground nesting birds and their habitats. This impact is usually attributed to one or both of the following causes: a) Direct impacts such as tramping of nests and disturbing nesting adults; b) Short and/or long-term modifications of the vegetation.

In a study of birds breeding in riparian vegetation in southeastern Oregon, Taylor (1986) found that the grazing history of an area affected the structural diversity of the vegetation, the number of breeding birds in the area, and the species diversity of the breeding bird community. Increased grazing was associated with negative effects on all three parameters.

Knopf et. al. (1988) studied birds inhabiting a riparian willow community in Colorado. Bird densities and vegetation parameters were measured. Vegetation variables found to be important in predicting bird densities were: a) Amount of vertical structure of brush; b) Number of quadrants in the sample area without brush; and c) Horizontal patchiness of the brush. Nine species of birds were common enough within the study area to provide sufficient sample sizes for analysis. Three bird species (Willow Flycatcher, Lincoln's Sparrow and White Crowned Sparrow), all habitat specialists, appeared to be intolerant of the vegetative structure that resulted from the influence of summer grazing. Three other species (American Robin, Brown Headed Cowbird, Red Winged Blackbird) were essentially not effected by the grazing. The remaining three species (Yellow Warbler, Savannah Sparrow, Song Sparrow), all riparian habitat generalists, appeared to increase in response to grazing.

In a study conducted in riparian habitat on the Blitzen River in Oregon, Taylor (1986) documented significant decreases in Passerine bird densities, shrub abundance, and shrub height with increased historic grazing. "The longer the time since the transect was last grazed correlated significantly with increases in bird abundance, shrub volume and shrub heights..." "Bird species richness increased with decreased grazing..." "Bird counts were 5 to 7 times higher on an area ungrazed since 1940 than on 2 areas grazed annually until 1980 (the year before the study)." The Willow Flycatcher and Yellow Warbler were found to be much more common on ungrazed or rarely grazed areas that on other parts of the study area.

In an enclosure-based study in Pennsylvania, Popotnik and Giuliano (2000) found that cattle grazing not only altered bird species richness and diversity, but also resulted in bird nest failures due to trampling. Increased amounts of vegetative cover and structure

increased the diversity of the bird community. Bird species richness was observed to be 1.6 times greater on controls compared to grazed areas. Thirteen bird species were found only on controls. No species were found only on the grazed areas. The only species found to be more common on grazed than on control streams was the Barn Swallow, a habitat generalist which generally does not nest in riparian vegetation.

Based on the above literature review, and many other studies (e.g. Mundinger 1976, Dusek 1975, Flieschner 1994, Jarvis and Harris 1971, Kirsch 1969, Bock et. al. 1984, U.S. Dept. of Agriculture 1997, Grzybowski 1992) it is clear that livestock grazing (particularly in riparian zones) can have significant effects on the bird community both in the short and long-term. This study is proposed to determine if livestock impact shrub and ground-nesting birds and their habitats within the Monument. Common bird species utilizing the livestock exclosures and paired sites include (but not limited to): Mallard, Yellow Warbler, McGillivrays Warbler, Orange Crowned Warbler, Wilson's Warbler, Willow Flycatcher, Dusky Flycatcher, Dark Eyed Junco, White Crowned Sparrow, Golden Crowned Sparrow, Rufus Sided Towhee, Ruffed Grouse, and Blue Grouse.

Objectives

Objective 1: Determine if current livestock impacts affect breeding bird species richness and abundance (number of birds) at sites monitored within the monument.

Objective 2: Determine the fate of individual nests located within exclosures and paired livestock-impacted sites

Objective 3: Determine livestock impact on habitat parameters known to be important to bird species richness and diversity (shrub height, shrub volume, percent of shrub cover, and stubble/grass height).

Methods and Materials

It is anticipated that the sample sizes associated with this study will be small, especially if stratified by vegetation type. It is unlikely that there will be any statistically significant differences detected in the bird richness and abundance data. However, it may be possible to draw inferences regarding livestock impact on birds in the Monument based on the combined information from the existing research available in the literature and the limited observations resulting from this study.

Hyatt Lake campground and the elk study area on Soda Mountain would provide additional study sites if fences could be maintained to exclude livestock more effectively. With longer fence lines, many more paired study sites could be established, thereby increasing the statistical validity of the project.

Repeat searches for individual nests sites would provide information fulfilling the requirements for objectives 1 and 2. Plant community transects completed in conjunction with other projects would supply all of the necessary plant compositional and habitat related information for this study.

Analyses

Vegetation structure measurements will be analyzed using the same statistical procedures described for 'individual variables' within the vegetation portion of the enclosure study.

Landscape level statistical validation may be achieved by examining the probability of exclosures showing higher number of bird species and number of nests than the paired grazed sites based on hypegeometric distribution (Sokal and Rohlf 1981).

4. Klamath Mardon Skipper Population Monitoring

Introduction

The Mardon Skipper is known to occur in only 3 meadows within the Monument. The butterfly has a disjunct range with one population in Northern California, and several populations in Washington state. The Oregon populations are restricted to the Cascade crest area between Soda Mountain and Fish Lake. One of the occupied meadows in the Monument is now mostly enclosed in a livestock enclosure installed in 2000.

Idaho fescue (*Festuca idahoensis*) is believed to be the larval host plant for this species in this area. However, larva will eat other grasses under laboratory conditions. Idaho fescue occurs throughout the Monument and surrounding landscape, but not the Mardon Skipper. Idaho fescue is not a dominant species in the 3 meadows in the Monument where the skipper occurs. Also, Idaho fescue is a dominant species in some places in the Monument where the skipper is not found. The relationship between the Idaho fescue and the Mardon Skipper thus remains unclear. Anecdotal observations indicate that Mardon Skippers concentrate their use in parts of meadows where the grass is relatively short compared to the average grass height for the entire meadow. In some years the occupied meadows are subject to substantial livestock impact. It is not known what impact livestock have on Mardon Skipper habitat. The literature (see vegetation section of enclosure study) indicates that grazing could change the species mix of grasslands in favor of annual grasses and weeds at the expense of native perennial bunch grasses such as Idaho fescue.

The following study is proposed to better understand the ecology of this rare butterfly and to determine possible livestock impacts on the abundance of the Mardon Skipper and its habitat. Included in the study are objectives aimed at quantifying livestock impact on Mardon Skipper abundance as well as more subjective observational studies aimed at elucidating the life history of the Mardon Skipper.

Objectives

Objective 1: Determine the effects of livestock impact on adult Mardon abundance.

HA1.1. Livestock show no impact on adult Mardon Skipper abundance (Prediction: chi-squared analysis shows no significant difference in adult butterfly counts between ungrazed and paired grazed site through the grazing season. [Prediction: Numbers of adult Mardon Skippers inside enclosure are not significantly higher than paired grazed site by greater than 5 % cover ($p=0.10$)]

HA1.2. Livestock show impact on adult Mardon Skipper abundance [Prediction: Numbers of adult Mardon Skippers inside enclosure are significantly higher than paired grazed site by greater than 5% cover ($p=0.10$)]

Objective 2: Gain insight on livestock impact on Mardon Skipper host plants and possible habitat.

Objective 3: Gain understanding of possible interaction of livestock impact on the life history of the Mardon Skipper.

Objective 4: Research plant community/habitat parameters facilitating Mardon Skipper persistence within occupied meadows versus nearby unoccupied meadows.

Methods

Following objective 1, the unfenced meadow most floristically similar to the enclosure will be selected as the paired site. Parameters included in an assessment of similarity include size, habitat conditions, and Mardon Skipper abundance. Sampling will consist of visiting the meadows during the peak of the butterfly activity season and counting the number of Mardon Skippers observed during time constrained searches of the meadows immediately prior to the advent of grazing and through the grazing season. Sampling will be conducted along predefined transects to ensure an equal sampling effort between treatments.

The following sampling scheme will ensure equal sampling effort and interspersion of sampling across time to meet assumptions required for statistical analysis:

1. Visits would start on or about June 1 (prior to the advent of grazing) and terminate at the end of the grazing season.
2. Paired meadows would be sampled on the same day.
3. Visits would be no more than 7 days and no less than 4 days apart. Sampling will occur along predefined transects of equal length.
4. Sampling would consist of 3 time constrained searches (10 minutes) for adult Mardon Skippers in each of the paired meadows.
5. Samples will be interspersed and timed to occur during peak Mardon Skipper activity periods.
6. Sampling would continue for a minimum of 3 years.

Objective 2 calls for repeat plant community transects (as defined in plant community section of the livestock enclosure study) prior to and through the grazing season. The temporal sequence of vegetation transects would provide information on changes in abundance of plant species, total cover, and sward height.

The determination of livestock impact on the life history of the Mardon Skipper (objective 3) requires and analysis of livestock impact on the plant community and habitat parameters described above concomitant with observations on the stage of development (egg, larvae, adult) and habit occupation by the different stages of metamorphosis.

Gaining an understanding of the habitat parameters supporting the Mardon Skipper (objective 4) requires plant community sampling within the range of occupied and closely allied unoccupied meadows. Plant community transects and environmental data should be collected after peak growth of the herbaceous component, but prior to the advent of the grazing season. Mardon Skipper abundance using repeat time constrained counts are needed tovalidate meadow preference. Multi-variate analyses may provide inference regarding Mardon Skipper habitat requirements.

Analyses

The analysis of vegetation and habitat variables will follow the analytical procedures described within the plant community section of the enclosure study.

Chi-squared analysis of the data will be used to determine if livestock significantly impact Mardon Skipper counts. Ideally, differences in pre-grazing counts of Mardon Skipper will be statistically insignificant (implying that differences in counts are not due

to intrinsic differences in the meadow). Livestock impact on Mardon Skipper abundance will be considered significant if counts in butterfly abundance differ following the advent of the grazing season. If the grazing season commences prior to the emergence of the adult Mardon Skipper, then impact will be considered significant only if there is a growing disparity in counts between grazed and ungrazed sites through the period of adult butterfly emergence (when numbers of butterfly individuals can be counted).

Canonical Correspondence Analysis will be used to identify important plant compositional and habitat attributes supporting Mardon Skipper abundance across the meadows examined for objective 4.

5. Effects of Livestock on Aquatic Mollusk Spring Habitat

Introduction

Livestock can impact springs by removing vegetation through grazing, trampling, contributing nutrients, increasing sediments, and, over time, changing the hydrology of a spring (Frest 2000, USDI 1998, USDI 2000). This study is designed to determine if the current livestock management regime in the Cascade-Siskiyou National Monument (CSNM) is compatible with maintaining healthy mollusk populations within isolated springs.

Life History of Mollusks

The life history of *Fluminicola spp.* make them especially sensitive to disturbances such as livestock grazing. They reside in perennial springs and headwaters with flowing water below 65° F. They breath through gills so the water needs to be flowing, well oxygenated, and with no excess sediment. They are unable to disperse widely because of the isolated nature of springs, and their need for immersion in water rules out dispersal by birds and mammals. Many species are endemic.

The snails live for one year, breeding only once before dying. Eggs are laid in the spring and hatch in 2-4 weeks. Any condition that impairs egg laying or survivorship of eggs or young could decimate the population (Frest 2000, USDI 1998, USDI 2000).

How Grazing May Affect Mollusk Habitat

Non-native ungulate activity can trample vegetation, eliminating a buffer that prevents silt from entering the spring. Excess silt fills the interstitial spaces in the substrate, reducing available habitat for mollusks and smothering eggs laid in the gravel (USDI 1998). Livestock impact may change the plant community associated with the spring, often introducing non-natives. This can alter the hydrology of the spring, reduce the amount of shade available, and elevate water temperatures. Fecal matter deposited in and around the spring elevates nutrient concentrations (nitrogen, phosphorous). This changes chemical habitat characteristics, which increases bacterial abundance and lowers the amount of dissolved oxygen available (USDI 2000). Aquatic vegetation is also affected by increased nutrients and vegetative change. A study in the Great Basin showed that calcareous algae predominates in undisturbed springs, while green algae frequently dominates in degraded springs (USDI 2000)

A number of native ungulates also utilize these springs, including elk and black-tailed deer. Although the potential always exists for overuse by these animals, it is rare (USDI 2000).

Objectives

Objective 1: Determine if aquatic mollusk numbers differ between paired livestock enclosure and livestock impacted sites.

HA 1.1: Mollusk numbers in livestock impacted areas are no different than within paired livestock exclosures [Prediction: chi-squared analysis show mollusc numbers within livestock impacted sites not to be more than 10% below livestock enclosure numbers (p=0.10)].

HA 1.2: Mollusk numbers in livestock impacted areas are lower than paired livestock exclosures [Prediction: chi-squared analysis show mollusc numbers within livestock impacted sites to be more than 10% below livestock enclosure numbers (p=0.10)].

Objective 2: Determine if dissolved oxygen levels are decreased by livestock impact.

HA 2.1: Dissolved oxygen is not different between paired livestock exclosures and livestock impacted sites [Prediction: t-tests show no significant difference in dissolved oxygen between paired livestock enclosure and livestock impacted sites (p=0.10)].

HA 2.2: Dissolved oxygen levels in livestock impacted sites are significantly lower than in paired livestock exclosures [Prediction: t-tests show significant difference in dissolved oxygen between paired livestock enclosure and livestock impacted sites (p=0.10)].

Objective 3: Determine if water temperature is increased by livestock impact.

HA 3.1: Water temperatures are not statistically different between paired livestock exclosures and paired livestock impacted sites [Prediction: t-tests show no significant difference in water temperature between paired livestock enclosure and livestock impacted sites (p=0.10)].

HA 3.2: Water temperatures in livestock impacted sites are significantly higher than in paired livestock exclosures [Prediction: t-tests show significant difference in water temperature between paired livestock enclosure and livestock impacted sites (p=0.10)].

Methods and Materials

Springs and headwaters within the CSNM have been surveyed for aquatic mollusks over a three year period. On BLM land within the CSNM, aquatic mollusks have been found in twenty-two springs. For a complete review of CSNM aquatic mollusks, see Frest 2000. Initial analysis of these data showed that springs shared few characteristics, and many contained endemic species of aquatic mollusks. This makes it difficult to design a study pairing control and study sites. Four springs possibly needing protection from livestock have or will have their headwaters fenced by June 2001 pending funding. This study will collect data from within and outside the enclosed area. Any additional sites requiring protection will also be added to the study.

Data will be collected twice per season, first in early summer, after the previous years adults have all died and the eggs have all hatched. The second will be in early fall, when the possible impacts of that seasons grazing can be assessed. At each visit, data for the following variables will be collected on either side of a suitable fence-line:

Dissolved oxygen

A dissolved oxygen meter will be used to measure percent air saturation, which is temperature compensated. Readings will be taken throughout a 24 hour period to determine the time period of lowest dissolved oxygen during the daily cycle. Longer-term monitoring will be timed to coincide with lowest dissolved oxygen concentrations.

The threshold for determining impacts will be a significant decline of available dissolved oxygen (p=0.10) outside of the livestock enclosure while dissolved oxygen remains higher within the livestock enclosure. Availability of dissolved oxygen is known to be important to the survival of other cold water organisms (salmonids, macroinvertebrates), especially those that lay their eggs in the substrate. Since aquatic mollusks are cold water obligates, live in flowing water, and lay eggs in the substrate, their dissolved oxygen needs may be similar.

Water Temperature

Hobo continuous temperature monitors will be placed at all sites (both above and below the fence-line) as soon as snow melt allows, and removed before snow arrives.
The threshold for determining a negative impact is a temperature of 65^0 F or greater (sustained for 4 hours) within the livestock impacted area while enclosure temperature remains lower. It has been established that temperatures of 65^0 F or greater will kill aquatic mollusks (USDI 1998), but it is not known how long aquatic mollusks need to be exposed to these temperature to die.

Plant Community Composition

The aquatic mollusk study sites will be included in the previously described vegetation monitoring which will describe the plant community.

Quadrat-based Habitat Parameters and Population Estimate

A suitable quadrat size for determining the number of molluscs per unit area will be chosen by determining the relation between number of molluscs versus quadrat area. A quadrat size including 50 to 100 molluscs will be chosen for ease of counting.

The quadrat will be thrown randomly into mollusk habitat areas of the study site (areas with flow that don't dry up and are not pooled) ten times on either side of the fence beyond any visible fence effect. All molluscs will be counted within each quadrat. Each plot will be photographed.

The threshold for identifying a negative impact will be a 10% decline mollusk numbers measured at a confidence level of p=0.10. Using 10% or more is to account for variability in the population due to sampling problems (aquatic mollusks are very difficult to collect) and natural population variability (such as habitat selection habitat, or mollusk movement).

Additional parameters measured within the quadrat will be:

- a visual estimate of vegetation will be made by life form;
- a visual estimate of exposed substrate and estimate of embeddedness (percent silt, sand, gravel, bedrock, wood); visual estimate and identification of aquatic vegetation

Analyses

Plant community will be described in comparison to transect data collected for other springs, seeps and wetlands as described in Projects I, J, and K. Treatment differences for quadrat-based estimates of cover for dominant plant life-forms and environmental criteria will be analyzed using a paired t-test (individual paired sites) or ANOVA blocked on site (all mollusk sites). Similarly, snail counts will be analyzed for differences across the fence line using non-parametric chi-squared analyses.

Table 3. Stand-alone Monitoring/Survey/Research Projects designed to provide a Landscape Context for the Enclosure Based Projects.

No.	Project Objective	Management Action/Comment	Variable(s)
A	General landscape condition survey for Klamath river ridges area	Will provide fuels data as well as rough estimates of weed impact and special plant community identification	Estimates of percent cover by species (herbaceous, shrubs and trees)
B	Reexamination of historical vegetation plots	Old SVIM and SCS plots have already been reexamined	Estimates of percent cover by species (herbaceous, shrubs and trees)
C	Rosaceous chaparral and Oregon white oak-juniper woodlands	Plant community surveys will help determine the range of these plant communitics	Examination of plant annual growth ring, historical photos, and soil profile to determine plant community dynamics
D	Gentner's fritillary	Current range and extent not known	Survey to identify presence and habitat requirements
E	Landscape-level rare plant monitoring and surveys	Generalized monitoring for rare plant species	Perform walk-through site visits on an annual basis
F	Weed monitoring/surveys	Several sources of information will provide us with an understanding of weed dynamics across the Monument landscape	Fixed transects, reexamination of vegetation plots, other existing surveys
G	Dietary overlap between livestock and native ungulates	Examination of diet for the range of large herbivores within the Monument landscape will provide information about potential interactions between native and non-native ungulates	Re-analysis of fecal composition data collected for deer, elk, and cattle in the late 1970's and early 1980's

Table 3. Stand-alone Monitoring/Survey/Research Projects designed to provide a Landscape Context for the Enclosure Based Projects.

No.	Project Objective	Management Action/Comment	Variable(s)
H	Winter deer habitat - shrub demographic studies	Maintaining winter deer browse may be dependent on maintaining a range of shrub age and condition classes across the landscape	Re-examination of shrub demographic data collected in the late1970's will provide some objective data concerning shrub condition at a range of sites within the Monument landscape
I	Fish habitat and riparian condition monitoring within grazed and ungrazed streams	Project dovetails with other riparian projects & water quality monitoring	Channel width/depth ratio residual pool depth pool frequency plant community structure shading
J	Riparian condition monitoring	Repeat of riparian survey completed in 1983	Bank condition logging impacts livestock impacts road construction impacts historic and current extent of various impacts
K	Stubble height monitoring	Monitoring protocol provides information on bank stability, vegetation structure, and species composition	Plant cover, stubble height, greenline transect protocol
L	Range utilization	Ongoing project	Percent utilization
M	Range trend	Ongoing project	Frequency
N	Rangeland condition	Ongoing project	Conventional rangeland condition assessment based on plant community composition only
O	Photo-monitoring	Database of photo-monitoring points	Changes in life-form abundance

V. PROJECTS PROVIDING CONTEXT FOR THE LIVESTOCK ENCLOSURE STUDY

The following surveys were designed to provide the landscape context for the enclosure/exclosure projects while also answering the needs for effectiveness monitoring for range management across the landscape.

The projects identified by Table 3 will provide information about plant communities and individual species (both plant and wildlife) considered important within the Monument and subject to livestock impact. Several surveys and monitoring projects focus on riparian condition relative to livestock impact, underscoring the importance of these habitats.

Emphasis is also placed on maintaining current rangeland monitoring while facilitating additional monitoring to fill in previously identified data gaps. The surveys will also answer the need for effectiveness monitoring to determine if current management is meeting Monument Aquatic Conservation Strategy (Appendix BB) and Grazing EIS (USDI 1983a) objectives (see introduction).

The remainder of the document defines projects identified in Table 3 which are to be initiated and completed within the 3-5 year period of monitoring set aside to examine livestock impacts on important resources of the CSNM.

A. General Landscape/Plant Community Condition Survey for the Klamath River Ridges Area

Introduction

Analyses of the plant community within individual plots at specific locations may provide little information concerning the condition of plant communities of the larger landscape. Plot-based field sampling intensive enough to achieve an understanding of plant community condition at the landscape-level is not economically feasible. Coarse walk-through surveys examining gross plant community composition can be used to attain a notion of the distribution of plant communities and associated range of conditions at the landscape scale. Plant community condition can be assessed relative to the dominant pathways of plant community change including weed invasion, the effects of fire suppression on shrub cover, and changes due to livestock impact using conventional range condition methodology (see project N).

This project is aimed at classifying plant community data collected within the CSNM to identify the range of plant communities and associated conditions.

Objectives

Objective 1: Create a map of plant communities for the Klamath River Ridges portion of the Monument.

Objective 2: Create a map denoting condition defined by the balance between native and non-native vegetation.

Objective 3: Create a map denoting condition defined by the cover abundance of shrubs reflecting past interaction with fire.

Objective 4: Create maps of plant community condition following conventional range management procedure (see project N).

Methods and Materials

Estimates of plant composition within large polygons of homogenous vegetation have already been conducted across the Klamath River Ridges Eco-region of the Monument. Polygons were defined at a level of resolution as similar to existing NRCS (Natural Resource Conservation Service) survey polygons. Canopy cover by trees and shrubs together with estimates of foliar cover estimates by individual herbaceous species will provide the information for defining plant communities. A total of four surveys by different investigators will be combined to create a seamless cover for the Klamath River Ridges Eco-region overlapping with the CSNM. Additional surveys may be conducted in other areas of the Monument described as components of the diversity management emphasis area.

The landscape surveys will be used to examine the richness of plant communities across the landscape. For all identified plant communities, the balance between native bunchgrasses and non-native annual grasses will be used as a measure of plant community condition from the weed invasion perspective. The data will also be used to assess landscape patterns of weed invasion (annual grasses and noxious weeds (see project F), and contribute to an understanding of conventional rangeland condition (see project N). Data will also be used to validate the NRCS (1993) framework of plant communities for the Klamath River Ridges portion of the Monument. The data will provide a basis for planning management by supplying a basic inventory of plant communities, fuels as defined by woody vegetation cover and plant community condition based on species composition.

Analyses

All of the standard multi-variate classification procedures described within the plant community portion of the livestock enclosure project will be used in this study. The resultant classifications will form the basis for creating maps within ARCVIEW. Standard GIS procedures will be used to depict plant communities and their range of conditions as defined by the balance of weeds and desired herbaceous vegetation. Overlap analysis with livestock utilization, soil characteristics, and other environmental characteristics will identify factors correlating with the range of plant community conditions (as identified by the balance between native and non-native vegetation) stratified by plant community.

B. Re-examination of Historical Vegetation Plots

Introduction

Plant community composition data collected by the NRCS (Natural Resource Conservation Service) and BLM between 20 and 30 years ago will provide the basis for understanding some of the recent historical changes in plant communities across the CSNM landscape. A comparison of species composition between 20 to 30 year old vegetation study sites and current composition may provide an indication of whether plant communities are moving towards a desired condition under the current management regime. Desired conditions can be defined in different ways.

Desired conditions may be defined by a relative domination of native species, an equitable distribution of plant life-form groups composed of native plants, or new populations of weed species establishing and increasing in abundance. Condition will also be assessed using rangeland management convention described under project N. Physical and management related factors involved in the inferred changes in composition will be examined using overlap analysis within the GIS environment, particularly regarding weeds (see project F).

Methods and Materials

Ninety-seven vegetation plots and polygons from historical vegetation surveys have already been re-examined. The Soil Conservation Service (SCS) plots and Soil and Vegetation Inventory Methods (SVIM) vegetation polygons date back 20 to 30 years. Species level composition data will provide an understanding of plant community changes across the range of plant communities of the Monument over the past three decades.

Objectives

Objective 1: Identify Monument-wide and allotment-wide patterns of vegetation change stratified by plant community.

Objective 2: Identify all site specific changes in vegetation considered significant (based on literature defined rates of sampling and observer error for the sampling methods employed).

Objective 3: Examine sites with significant compositional changes as case studies.

Objective 4: Interpret the plant composition data using the range of perspectives on condition (weed invasion, shrub abundance as a consequence of fire-suppression, conventional range condition).

Objective 5: Contribute data to other projects (Project F, M, and N)

Analyses

The field data will classified into plant community and conventional range condition. Site specific indicators will provide inference about the range trend direction. More objective examination of the data will identify "significant" plant compositional changes based observer and sampling error rates reported in the literature (West and Hatton 1990). Repeat estimates of species abundance with overlapping confidence limits derived from the literature-derived rates of observer and sampling error will be considered not significantly different from each other.

Sites showing significant changes in species abundance will be considered for local case studies. More detailed examination of site history (including past management), soil conditions, and local plant community composition may provide insight concerning local plant community dynamics. Within plant communities, Canonical Correspondence Analysis (Kent and Coker 1992) may be used to elucidate plant community dynamics relative to the above factors.

Examining the same data within the GIS environment may identify spatial patterns particular to allotment boundaries, soil patterns, and other features within the GIS. Precipitation data will be examined to ascertain that observed differences are not due to marked difference in precipitation pattern and abundance for those years during which data was collected.

C. Rosaceous Chaparral and Oregon White Oak-Juniper Woodlands

Little is known about the range, distribution and condition of these plant communities. Field surveys and information from other projects (A, B, and M) will be used as an initial assessment of these plant communities. Together with the aging of woody shrubs and trees by examining annual growth rings, the above data will provide a better understanding of plant community dynamics and so identify future research/ management needs.

D. Gentner's fritillary (*Fritillaria genteri*) Monitoring

Introduction

Genter's fritillary (*Fritillaria gentneri*) is a local endemic plant that is federally listed as endangered. This lily has one documented occurrence within the Cascade-Siskiyou National Monument. This occurrence is significant as it is the most southerly known population, is an isolated breeding population, and is one of the larger populations known. No formal monitoring of this population has occurred. Abundant habitat for this rare plant exists within the southern and southwestern portion of the Monument, which is a portion of the Diversity Emphasis Area (DEA). Much of this area has not had botanical surveys for this species, or any of the BLM Special Status Plant Species. The *Fritillaria gentneri* population in the Monument occurs in an ecotone area between open Oregon white oak/Mountain Mahogany/serviceberry and a Douglas-fir/white fir forest, just up out of a small riparian area. Other populations of Fritillaria occur in similar habitats, usually in open oak woodland mosaics, often in the transition or ecotone between oak communities and chaparral, grasslands or denser oak or fir and pine forests. The following describes monitoring and survey methodologies for this rare plant.

Objectives

Objective 1: Identify potentially suitable *Fritillaria* habitat.
Objective 2: Map and survey suitable habitat.
Objective 3: Document and evaluate new occurrences of Gentner's fritillary.
Objective 4: Develop a better understanding of life history, physiology, and population biology.
Objective 5: Monitor populations to measure demographics, trends, and analyze any affects from herbivory, and successional changes.
Objective 6: As livestock do not utilize this one population, this site will serve as a baseline population and will be compared to grazed populations found from the landscape surveys.

Methods and Materials

Landscape Surveys

Landscape scale surveys will be used to validate presence and absence of Genter's fritillary within the southern and southwestern portion of the Monument. Most of the un-surveyed habitat for this rare lily lies south of Tyler Creek, and west of the power line that intersects Tyler Creek and runs southeast to Agate Flat. Small un-surveyed areas also occur in the eastern portion of the DEA, however much of this area has had botanical surveys. The northern portion of the Monument also has small areas of un-surveyed habitat.

Using aerial photographs, existing vegetation information, and professional knowledge, landscape level surveys will be conducted during the blooming period for Gentner's fritillary. It is estimated that of the approximately 32,000 acres within this portion of the Monument, less than 6,000 acres will be identified as suitable habitat and surveyed. Populations of other rare plants found in the communities surveyed will also be documented to further the understanding of the diversity in the Cascade-Siskiyou National Monument.

Plot-based monitoring

Permanent plant monitoring will occur in the 1 documented population and at least 2 new plots will be established if new occurrences are found in the landscape level surveys.

The monitoring consists of 3 parts.

1) Annual revisits will census the entire population and count flowering *F. gentneri* and *F. recurva* individuals (a congener) and do count estimates of vegetative *Fritillaria* spp. leaves. The standard BLM Rare Plant sighting form will be used to document this information. New occurrences found in landscape surveys will also be annually revisited. Every population of this listed plant in the Monument will be visited annually during the blooming period. This monitoring will provide census trend data for the existing population in the Monument.

2) Ten (10) 1 x 1 meter permanent plots will randomly selected within the existing population to annually monitor individual plants, herbivory, and physiology. Each plot needs to contain at least 1 flowering *Fritillaria gentneri* plant at establishment, which will be tagged with 1/16" diameter steel pins with aluminum tags, placed approximately 3 cm from the base of the plant on the north side. Vegetative plants within the plots will also be tagged to see what percentage of these plants are *F. gentneri* or *F. recurva*. Based on vegetative characteristics, these two species are indistinguishable. Each plot will be monumented (distance and bearing) from the one of the fence posts placed for the vegetation transect (below). The inside of each corner of the 1 x 1 m plot will be permanently staked with steel pins so that a 1 x 1 meter frame can be accurately placed on it. Information on presence/absence, herbivory, number of buds, flowers fruits, basal leaf width and length of vegetative leaves will be taken for each plant within the plot. Every plot will be photographed. Estimates of cover by species will be done for every micro plot including population counts for invading species, like yellow star-thistle. The plots will be read between May 1st – May 20th every year for three years. At that time, a decision will be made whether to continue the monitoring.

3) A 100 meter Point and Cover transect, monumented at the beginning and end with steel fence posts will be conducted every year to document changes in the plant community.

Analyses

New sites documented will be included in the monitoring portion of this document. Repeated site visits will monitor the trend in these populations.

The total census information (counts) will be analyzed with non-parametric statistics for annual information to detect significant changes in total population numbers, assuming the surveys find more population. Information collected within the 10 plots will be analyzed using paired t-tests (2 year comparisons) or for data 3 years and older using a repeated measures ANOVA will be used. Vegetative point and cover information will be analyzed following methods outlined in the community section of this document.

E. Landscape level Rare Plant Monitoring & Surveys

Introduction

A number of other rare plant species are documented from the Monument, and recent surveys have focused mainly in areas where recent BLM activities have occurred. Some habitat focused surveys in the southern and southwestern portions of the Monument are proposed for Gentner's fritillary. These surveys are likely to document other populations of rare plants associated with similar habitat in this area of the monument. Many of the occurrences documented in the Monument have not been revisited or informally monitored since they we initially located, some as early as 1979. To clearly assess the status of these rare elements, re-visits and documentation of some populations must occur. Formal monitoring of certain species is proposed.

Objectives

Objective 1:Establish permanent monitoring plots for high priority species to gather needed demographic data, assess trends, and threats within the next three years.
Objective 2:All high priority populations will be informally monitored at least once in the next three years to assess the effects of grazing using qualitative methods (counts, photopoints, site condition assessment) as part of the grazing study, and to gather the needed information so as to develop a long term monitoring design and plan.

Objective 3:For all other Bureau special status species documented in the Monument, an informal monitoring schedule (revisits) will be developed such that at least 70% of all known occurrences of Bureau Special Status Plants will be revisited at least once in a ten year period.

Methods and Materials

Formal Monitoring

The formal monitoring methods cannot be well defined, as specific information needed to design monitoring is not currently known. Plots will generally follow methods defined for *Calochortus greenei* or *Fritillaria gentneri* (above). Site specific monitoring objectives and methods will be developed and implemented within three years. The monitoring frequency will vary by species but will generally occur annually unless identified differently in specific monitoring plans.

Species are prioritized based on rarity, and perceived threats. Specific information is given in parenthesis.

1. *Fritillaria gentneri* (described above)
2. *Calochortus greenei* (described above)
3. *Astragalus californicus* (1 population in the Monument in the Scotch creek RNA)
4. *Lathyrus lanszwertii var. tracyi* (1 population documented, also in the Scotch creek RNA; monitor with *Astragalus californicus*)
5. *Limnanthes floccosa* ssp. *Bellingeriana* (Populations near Lincoln and 1 small occurrence in the Oregon gulch RNA)
6. *Cypripedium fasciculatum* (1 Existing monitoring plot)
7. *Plagiobothrys figuratus* ssp. *corallicarpus* (vernal pool species)

At least three 5 meter x 1/2 meter permanent linear plots are placed within a population. Information is collected within 1 x 1/2 meter micro-plots. Qualitative, census, frequency, or density measures will be taken, depending on the species and the specific objectives developed. For cases where the populations are very small (e.g. *Lathyrus lanszwertii var. tracyi*), the entire population may be measured. For other larger populations, permanent plots will sample these occurrences.

Informal Monitoring

For all other rare plant species in the Monument, at a minimum, 70% of all existing occurrences will be revisited at least once over the next ten years, starting in 2001. Within the next three years of the grazing study, an effort will be made to revisit at least 1population for each of the 24 Bureau Special Status Plants documented for the Monument that occur in areas that are utilized. Information will be recorded using the Standard BLM Rare Plant sighting form, any threats will be assessed and populations will be accurately mapped (GPS). Data will be stored on the Medford Rare Plant Database and GIS and at the Oregon Natural Heritage Program. Comparisons of past visits will be used to assess general population trends. Depending on the status, condition, and threats, populations may be revisited more than once in the ten-year period, and if necessary, permanent plots could be established. Activities or conditions potentially affecting populations would likely trigger the establishment of formal monitoring plots to assess effects and trends.

Analyses

Specific analytical processes will be developed in the monitoring plans developed for these plant species that are formally monitored. Normally, paired t-tests and repeated measure ANOVA will be used to analyze significant changes in permanent plots. Informal monitoring data (counts) from different time periods can be analyzed using chi-square analysis to assess trends.

F. Examining Patterns of Weed Abundance

Introduction

The establishment of new populations of weeds or increases in the abundance of noxious and other weeds are indicators of the degradation of native plant communities. Existing maps of weed locations can be used to determine which plant communities are at greatest risk to weed invasion. Many factors contribute to the rate and extent of weed invasion. This GIS based project uses overlap analysis to examine relationships between weed abundance and a range of environmental factors thought to play a role in the process of weed invasion. Factors considered include: soils (type, texture, and mineralogy), plant community, topography (slope and aspect), livestock utilization (including hotspots of utilization), range management strategy, and road proximity.

Many authors have implicated livestock in the introduction and spread of weeds on western rangelands (Belsky and Gelbard 2000). DeClerck-Floate (1997) concluded that livestock have the potential to be very effective spreaders of certain weed seeds by transporting burrs in their fur. Allen and Bartolme (1989) noted higher numbers of weeds in grazed versus ungrazed clear-cuts in northern California.

Based on the above information, permanent transects will be located across the CSNM landscape to more accurately measure the rate of weed invasion within susceptible plant communities.

Objectives

Objective 1: Identify Monument-wide and allotment-wide patterns of weed presence/absence or increase (where temporal data exists) stratified by soils (type, texture, mineralogy), NARCS (1993) defined plant communities, topography, rangeland management strategy, livestock utilization, proximity to roads, etc.

Objective 2: Establish transects to more accurately monitor future rates of weed invasion within susceptible plant communities of the CSNM.

Methods and Materials

Several sources of point locations for noxious weeds exist within the CSNM. Past and ongoing BLM sponsored weed surveys form the basis of the noxious weed location maps. Other field observations and senior student projects from Souther Oregon University have also contributed to the weed location map. Plant community surveys and analyses derived from other projects (projects A, B, J, K and M) will be used to analyze the patterns of weed abundance concomitant with environmental factors (soil characteristics, slope, topography, existing plant community, range management strategy, and livestock utilization) across the landscape.

Analyses

The maps of weed abundance resulting from weed surveys, general landscape condition surveys, and the re-examination of historic vegetation plots will be intersected by GIS coverages of the range of factors thought to play a role in the process of weed invasion. Each factor, for example, soils, are divided into a number of classes (for example, the range of soil types, or mineralogy classes). Overlap analysis of soil types with weed presence/abundance will identify soil types most commonly associated with a particular weed species. The strength of the relationship between soils (and a particular class of soils) will be indicated by the percentage overlap between weed presence/absence and the range of classes for the factor of interest. A ranking of the maximum percentage overlap with any class associated with the range of factors is a measure of the relative importance of that factor.

Canonical Correspondence Analysis will be used to verify relationships between plant community/weed abundance and attributes relating to the physical environment. Results from this and other projects will contribute to a Monument wide understanding of weed invasion.

G. Dietary Overlap Between Deer, Elk, and Livestock within CSNM Winter Deer Habitat

Introduction

The grazing EIS states: "The amount of forage removed by cattle during the summer months on elk winter range could play a significant role in winter elk survival due to dietary overlap." Similar interactions may occur between deer and livestock.

Research literature indicates that livestock grazing has the potential to impact forage quality, forage amount, and foraging site selection by deer and elk. The competitive

relationships are not clear, and it appears that the effect of livestock grazing on the forage resource available to deer and elk are highly variable and are highly situation dependant. Variables that appear to be important in determining effects of grazing include: timing, duration, and intensity of livestock use, forage species being utilized, variation in seasonal and annual weather patterns, and type of livestock on the range [steers v.s. cow/calf] (Bernardo et. al. 1994, Loomis et. al. 1991, Ragotzkie and Bailey 1991).

Some studies from the western United States indicate that livestock grazing under some conditions is generally neutral or even beneficial with regard to forage resources available to wild ungulates (Austin and Urness 1986, Stevens 1966, Thilenius and Hungerford 1967, Roberts and Tiller, 1985, Dragt and Havstad 1987).

Other studies cite reduced forage quality and or quantity and deer/ elk avoidance of areas recently grazed by livestock (Austin and Urness 1986). Some studies indicate that deer and elk actively avoid livestock on shared range (Stevens 1966, Prasad and Guthery 1986, Ragotzkie and Bailey 1991).

Some studies indicate that factors other than livestock presence, and current and historic livestock grazing are very important in forage site selection by deer and elk. These factors include: availability of hiding cover, % slope, aspect, distance to open roads, and availability of thermal cover (Wambolt and McNeal 1987, Lyon 1979, Black et. al. 1976, Edge et. al. 1988).

Given that there is the potential for competition for resources (space and forage) between cattle and wild ungulates in the Monument, and the importance of the Monument to regional wild ungulate populations the competition issue warrants study. Accordingly, existing fecal content data collected during the late 1970s and early 1980s will be analyzed to assess the degree of interspecific competition for forage at that time.

Together with patterns of livestock utilization (Project L) and results from past browse studies(Cole-Browse Utilization Transects - Project H), the fecal analysis data will be used to examine the possibility of interaction between livestock and native ungulates (deer and elk) on the basis of diet.

Objectives

Objective 1: From samples collected in the early 1980s, determine if diets for cattle, deer, and elk within the Monument overlap based on fecal plant species composition.

HA1.1: There is no overlap between the diets of cattle, deer, and elk within the Monument (Prediction: There is no interspersion of points representing cattle, deer, and elk fecal plant species composition within ordination space; data representing cattle, deer, and elk fecal species composition do not fall within the same classes defined through standard classification procedures).

HA1.2: There is overlap between the diets of cattle, deer, and elk within the Monument. (Prediction: There is interspersion of points representing cattle, deer, and elk fecal species composition within ordination space; data representing cattle, deer, and elk fecal species composition do fall within the same classes defined through standard classification procedures).

Objective 2: From samples collected in the early 1980s, determine if seasonal shifts in fecal plant species composition occur for livestock, deer, and elk.

Objective 3: Where dietary overlap occurs, determine if use is concurrent by using graphic overlay of species-time utilization histograms for livestock, deer, and elk.

Objective 4: Determine if plant species utilized by livestock and native ungulates are in short supply or threatened through lack of reproduction and/or over-use.

Methods and Materials

Fresh fecal samples from livestock and native ungulates (deer and elk) were collected intermittently through the whole year from 1979 through 1981. The Composition Analysis Laboratory at Colorado State University identified relative utilization of individual plant species expressed as a percentage of recognizable plant fragments.

In addition to the fecal analysis data, this project makes use of other existing information (shrub browse data, livestock utilization maps, and plant community maps) and information derived from other projects. All data layers and related projects will contribute to the final interpretation of livestock interaction with native ungulates.

Analyses

Fecal analysis yields plant species compositional data expressed as a percent. Standard ordination and classification tools can be used to examine for dietary overlap between livestock and native ungulates. Direct ordination [gradient analysis - Kent and Coker 1992)] will be used to examine seasonal trends in fecal composition. Together with browse utilization data, seasonal trends may determine if use of any forage/browse base occurs simultaneously by different animals, or if use is separated by time.

Fecal analysis data was collected within three regions of the CSNM including Agate Flat, Keene Creek Ridge, and Skookum Creek. If dietary overlap between livestock and native ungulates is observed in any of these areas, livestock utilization, vegetation maps, and data from Cole Browse transects will be examined to determine if the plant species in question are in short supply within the pastures of concern.

Standard GIS procedures will be used to examine relationships between diet overlap, livestock distribution (current and historic), forage/browse utilization patterns (see projects H, and L), plant community (see project A, B, J, K), and maturity and age classes as discerned by the Cole Browse transects (see project H).

H. Winter Deer Habitat - Shrub Demographic Studies

Introduction

Site specific surveys of shrub form and maturity class provide information about the past history of shrub browse use by livestock and native ungulates. Shrub form class indicates the availability and degree of hedging by browsing on a particular shrub species. High rates of browsing are indicated by form classes restricted to browse height (the entire shrub can be reached by the browsing animal) and a high degree of hedging. Maturity classes indicate whether shrubs at the site examined are reproducing and likely to persist on the landscape. A literature review will be used to characterize the range of shrubs utilized by livestock and native ungulates. An understanding of life-history, longevity, and response to browsing as well as other common ecological processes on the Monument will provide a suitable background for the interpretation of the shrub form and maturity data. A re-examination of the transects may provide information about changes in shrub form and maturity class over the last 20 years.

Objectives

Objective 1: Determine the nature of browsing pressure on shrubs considered to be a critical winter browse source for deer.

HA1.1: Browsing pressure is negligible (Prediction: Form class distribution is weighted heavily towards classes extending beyond the reach of livestock and native ungulates and showing negligible hedging).

HA1.2: Browsing pressure is substantial (Prediction: Form class distribution is weighted heavily towards classes entirely within the reach of livestock and native ungulates and showing high degrees of hedging).

Objective 2: Examine the health of the shrub population as defined by the distribution of shrub maturity classes.

HA2.1: Shrub populations are decadent (Predictions: few seedlings and young shrubs; distribution of shrub maturity classes is weighted heavily towards mature and decadent maturity classes).

HA2.2: Shrub populations are healthy and likely to persist in the longer term (Predictions: all maturity classes are represented, with no domination by a particular maturity class).

Objective 3: Determine if shrub form and maturity class distribution has changed in the last 20 years (compare class distribution patterns using histograms).

Methods and Materials

Histograms showing the distribution of form and maturity classes will be assessed to examine shrubland condition at the sites examined. The sites examine will be mapped to determine if the data can be generalized for the entire landscape. Additional study sites will be examined if the distribution of transects is inadequate or if other commonly utilized shrub species (as identified by project G) are not considered. Final results will be stratified by plant community. Transects will be repeated during the ensuing two years if conditions are considered to have changed considerably.

Analyses

In this study, data from historical transects located across the Monument landscape in the early1980s will be re-analyzed to determine the distribution of age and form classes. Data will be interpreted relative to the biology of the shrub species in question. For example, the dynamics of resprouting versus obligate seed reproducers are likely to differ in accordance with their life-histories. The fecal analysis data will indicate whether additional surveys need to be implemented within other shrub dominated communities.

I. Fish Habitat and Riparian Condition Monitoring in Grazed and Ungrazed Streams

Introduction

As a result of the March 18, 1997 Biological Opinion from the National Marine Fisheries Service (NMFS), the BLM began a range-riparian monitoring program. As part of BLM's permit, NMFS asked that the BLM monitor the impacts of cattle grazing on listed anadromous fishes. Currently, the listed species include coho salmon and steelhead. Southern Oregon/Northern California coho salmon, *Oncorhynchus kisutch*, listed as Threatened under the Endangered Species Act. Klamath Mountains Province steelhead,

O. mykiss, proposed to be listed March 31, 2001 as Threatened under the Endangered Species Act. BLM has expanded this monitoring program to include monitoring resident fish habitat within the CSNM.

This project meshes with Projects J and K to provide a historical and landscape view of stream and riparian condition in the CSNM. Project J aims to repeat historical surveys in riparian areas and streams, while Project K supplements the riparian surveys by collecting plant community and stubble height information.

Simultaneously, several landscape-level efforts to monitor water temperature, turbidity and stream flow will continue to provide an understanding of water quality condition across the CSNM. Although these water quality parameters are affected by all the activities within a watershed, this information is critical for assessing whether changes in riparian condition could be improving or worsening water quality. In addition, the BLM allotment assessment process requires that water quality issues be evaluated and discussed when assessing allotment condition.

Results from this monitoring must be combined with repeat surveys at historical survey plots, riparian plant community monitoring in the enclosure study, long-term photo point monitoring throughout the CSNM, and hydrologic monitoring to provide a more thorough understanding of the impacts of grazing on fish and stream systems in the CSNM.

Objectives

Objective 1: To assess impacts of cattle grazing on certain aspects of fish habitat.

Methods and Materials

In order to determine whether cattle grazing impacts aquatic habitat, BLM chose to monitor those variables the literature suggested could be impacted by livestock: bank vegetation condition, instream vegetation condition, extent of overhanging banks, shade, bank angle, and feces deposition. BLM also quantifies fish habitat and channel shape at the monitoring sites. Although fish habitat and channel shape are affected by every activity happening upstream of the sites, some factors (e.g. changes in pool structure at the monitoring site, changing bank condition) can be assessed with these otherwise watershed-oriented methodologies.

The following methods are used: "Greenline" riparian survey (see Appendix B), monumented cross-section channel survey, habitat type survey following ODFW protocol (Moore et al. 1998), some visual assessment, and permanent photo points with pictures taken at the beginning and end of the grazing season.

The following table includes proposed threshold values for some of the protocol variables. All of these "thresholds" are merely estimates. Note that values for pool frequency, residual pool depth and shade only apply in forested areas, not meadows. Monitoring sites will include areas with and without obvious ungulate impact, in both meadow and forest areas. Some monitoring sites may be located outside of the CSNM, in order to find an appropriate cross section of riparian types and livestock use levels.

While copious literature exists regarding the assessment and monitoring of grazing impacts, few studies actually make recommendations of specific levels of impacts. Most studies rely on the investigator to make an assessment based on his or her knowledge of a stream system, stream ecology, physical processes, and the historical and management context. This is very appropriate, because impacts to streams vary depending on a stream's gradient, the underlying geology, available substrate, upland vegetation community and other factors (Rosgen 1996). Locating monitoring sites in different

riparian and channel types will help define appropriate threshold values specific to the CSNM streams. Table 4 summarizes thresholds derived for this riparian monitoring project.

Objective 1: Use original study design to define the current extent of observable logging, road building, and grazing impacts within the CSNM

Table 4. Proposed Thresholds of Selected Variables used to Analyze Grazing Impacts on Fish and Instream Aquatic Systems in the CSNM.

Parameter	Threshold	Rationale
Width to depth ratio[1]	Narrow floodplain (A & E channel types) = <12 Wide floodplain (B & C channel types) = >12	An inappropriately large width:depth ratio can increase stream temperature, increase fouling by algae, and decrease quality of good aquatic habitat. Bankfull stage shear stress decreases, which changes velocity and consequently induces sediment deposition. Channel widening can be caused by degrading streambanks. *Note*: In some stream channel types, downcutting and narrowing of the stream channel has the opposite and equally deleterious effect.
Residual pool depth (forested streams only)[2]	Low gradient (slope <3%) or small (<7m width) = > 0.5m High gradient (slope>3%) or large (>7m width) = >1.0m	Pool depth is essential for quality fish habitat.
Pool frequency (forested streams only)[2]	<20 channel widths between pools	Pool frequency in an index of how well-distributed good quality habitat is throughout a stream.
Plant community structure[3]	0% loss of woody species 0% loss of riparian-dependent plant species 0% increase in bare ground 0% decrease in willow height	Woody species (e.g. willow) protect stream banks from erosion, create cover for fish–critical in meadow areas, provide habitat for aquatic macroinvertebrates, and are an important allocthonous food source. Grasses and forbs are important for bank stabilization and trapping fine sediments during floods.
Overhanging vegetation (within ~0.5m of water surface)[4]	Overhanging vegetation on 50% or more of the streambank, especially on outside bends.	Overhanging vegetation provides critical cover for fish, resting areas for the adult forms of aquatic insects, and important food sources for streams (with leaf fall).
Shade (forested streams only)[2]	West side streams <12 m = >70% (reach average) West side streams >12 m = >60% (reach average)	Shade is critical to keep stream temperatures low and aquatic systems healthy.

[1] Rosgen, D. 1996.

[2] Moore, K., K. Jones, and J. Dambacher. 1998.

[3] Platts, W.S. and R. L. Nelson. 1985.

[4] Leonard, S., G. Kinch, V. Elsbernd, M. Borman, and S. Swanson. 1997.

Objective 2: Determine if current spatial extent of observable impacts differs from the early 1980s.

Objective 3: Determine if the current magnitude of livestock impacts as measured using the livestock impact indices differs from the early 1980s.

Objective 4: Determine if localized impacts mapped during the 1980s surveys remain under the current management regime.

Repeat of 2 of the 1980 riparian condition survey objectives

Objective 5: Classify the riparian zones as to habitat diversity, condition, and trend

Objective 6: Identify the causative factors which are detrimentally influencing site specific the riparian communities.

The objectives for the repeat riparian habitat project are the same as those listed above. In addition, this project would attempt to discern if aquatic habitat condition factors have changed in Jenny Creek over the last 20 years.

Methods and Materials

The Monument contains 54 monitoring sites of the total originally falling within the Klamath Resource Area at the time of the survey (1981-1982). The methods and materials are reproduced verbatim from a report by Montgomery and Culbertsom (1983):

"This riparian zone survey was conducted during the 1981 and 1982 field seasons in the Butte Falls and Klamath Resource Areas, Medford District, Bureau of Land Management (BLM). An attempt was made to survey 100% of the Class I streams in both resource areas. Class II streams were randomly sampled [6.3% in the Butte Falls Resource Area (BFRA) and 5.3% in the Klamath Resource Area([KRA)].

Transportation maps of the resource areas were utilized to determine the sections of Class I and II streams on BLM administered lands. Each stream segment was numbered, Class I's by mile and Class II's in quarter mile segments. A random numbers table was used to select the Class II streams to be sampled. A sufficient number was selected to cover the time allotted. These segments of "miles" as they will be referred to hereafter, were numbered separately for each resource area.

Each section or mile of stream was surveyed separately. For each mile, a map was drawn showing significant features within the riparian zone, stream, and upland. A species list of the flora and fauna was maintained. For each plant species, an ocular estimate of percent foliar cover was made. Other measurements included aspect, slope, canopy cover, bank slopes, stream width anddepth, and riparian zone width. A mean and range was noted for each measurement. Streambed composition and character were noted. Terrestrial vertebrate and avian species were recorded when observed or identified by sign (scat, track) or vocalization (song).

Three numerical ratings were made for each vegetative community of each mile surveys: the Habitat Diversity Index (HDI), condition, and trend. The HDI is an evaluation of the complexity of the vegetation, physical features, and unique features of a site. In general, riparian wildlife communities are influenced more by structural form of the vegetation than by species composition. The type, size, and arrangement of canopy, shrubs, and herbaceous vegetation are major contributors to the suitability as a site for wildlife.

The riparian zone condition is a numerical rating of the overall condition of the community. It is based on the vegetation age and composition, bank conditions, and the impacts of logging, grazing, and/or roads. The total rating is classified as excellent, good, fair, or poor condition.

The observed apparent trend is a numerical rating of the progress of succession of the community. It is rated as downward, static, or upward, based on plant vigor, seedling establishment, age class representation, vegetation composition, amount and distribution of litter, and the amount and severity of pedestalling (see Appendix B, Riparian Zone Survey Forms).

Influences upon the trend were observed and ranked according to their relative impact upon the riparian zone. Logging, grazing, and roads were the principle factors influencing the successional state of the communities and the amount of influence was a subjective interpretation of the examiner based on observable influences.

All Class I streams and Class II streams with a riparian zone were classified. Those Class II streams without a riparian zone did not have a condition, trend, or HDI rating completed. Each riparian community of the Class I streams had a step-point transect performed. The step-point provides relative percent of each plant species and plant forms found in each canopy level of the sample. Each transect had a 50 meter transect parallel to the stream on each side and a minimum 5 m perpendicular transect from the stream edge on each bank. Step-points were conducted at the most "typical" site in each community.

Horizontal-vertical vegetation structure drawings were made at the saw location as the step-point. One was drawn in a 10M x 2M strip on the left bank, a second was perpendicular from the stream edge, which included the topography of the stream channel and banks. Step-points and horizontal-vertical drawings were not done on Class II streams".

Some of the sample sites from the riparian crew overlap with the survey sites from the fish crew. In an effort to save time and money, only these sites - where both historical riparian survey and historical fish habitat survey data were collected- will be re-surveyed.

Of the historical data collected, the following categories lend themselves to repeat collection: shade, bank condition, pool:riffle ratio, channel substrate, aquatic vegetation, and field notes on upland condition.

Much of the data collection for this project is subjective in nature. Following field trials, the most objective elements of the data collection format will be adopted for the repeat riparian survey to be completed within the following 3 years. Sample forms and a more detailed explanation of features are supplied in Appendix B. Each study site will host a permanent transect along which plant compositional and stubble height data will be collected (see Project K).

Analysis

The subjective nature of the data complicate data analysis. LOGIT modeling, Log Linear Modeling and suitable forms of categorical data analysis may be used to effect a statistical analysis of indices measuring bank condition, and impacts due to grazing, logging, and roads. Changes in index value between the early 1980s and early 2000s will be summarized in a table to allow an assessment of current condition relative to the time of the original survey. Current and historical condition as indicated by the range of indices will be included in GIS for spatial analysis. Summaries of change in index value will be stratified by plant community, geographic and management boundaries

(watershed, range allotments/pastures), and range management criteria (grazing strategy).

J. Repeat Riparian Condition Survey

Introduction

Riparian zones are one of the most limited, (Elmore 1987) and most sensitive (Kaufman and Krueger 1984) habitats in the western landscape. Riparian zones are the most productive and diverse habitats in much of the west (Thomas et al. 1979) and frequently produce 10 times the forage of adjacent upland forested sites (Elmore1987).

The link between riparian vegetation diversity, especially in the shrub and overstory layers, and riparian wildlife diversity is well documented (Kauffman and Krueger 1984, Taylor 1986, Szaro et al. 1985). Wildlife populations adjacent to riparian zones are affected by habitat conditions and resultant wildlife populations in the riparian zones (Kauffman and Krueger 1984). Healthy riparian habitat usually supports species not found in the uplands and thus contributes to species diversity at larger landscape scales.

Riparian areas are also play a critical role in channel process and aquatic habitat. Riparian trees and shrubs slow flood water and trap flood debris (Platts 1991). Trees fall into the stream during flood events, creating pools and trapping gravels for spawning habitat. Trees and shrubs also provide shade and in some cases, cover for fish. Grasses and forbs in floodplains trap fine sediments during floods (Platts 1991). In meadows, grasses and shrubs stabilize stream banks with their roots. The stream scours against these banks at curves, creating pools and deep overhanging banks. Riparian vegetation also provides an important food source for instream insects (Allen 1995).

Assessments of riparian zones were completed between 1980 and 1982 in preparation for the Medford District Grazing EIS (USDI 1983). Fifty-four of the assessed sites cover the current CSNM. The twenty year old data includes handwritten site observations, site maps showing coarse vegetation composition, cut bank location, and other localized impacts. Indices rate livestock, road construction, and logging impacts, as well as the structural and compositional diversity of vegetation (see Appendix B). While step point data was collected at key locations, these were not permanently marked or located on maps, and may therefore not be repeatable. This project aims at replicating observations on vegetation structure, composition and impacts due to grazing, road construction, and logging. Together with a comparison of the 1980 (used at the time of the study) and more recent aerial photos, this study will provide information concerning the current extent of logging, road building, and livestock impacts to riparian areas of the CSNM relative to the early 1980s.

In addition to riparian surveys, BLM fisheries teams completed fish habitat surveys throughout the Jenny Creek drainage in 1981 and 1982. Teams surveyed fish-bearing streams on federal land. For every ˜ mile, they estimated or assessed riparian condition, shade (% channel shaded at noon), bank damage (bank breakage and trail erosion), stream channel width, pool size, pool:riffle ratio, and channel substrate. They also used a form to rate bank stability, habitat quality, substrate, and habitat structure. For every 4 to 5 quarter-mile segments, the survey teams made additional field notes on grazing (livestock, deer, and elk), timber harvest, and recreation. They estimated sinuosity and gradient. They also noted presence and abundance of different kinds of aquatic vegetation.

K. Livestock Utilization and Stubble Height Studies

Introduction

This project is designed to support Project J (Repeat Riparian Condition) to quantify plant community composition and utilization by livestock in riparian and wetland plant communities of the CSNM. Permanent transects will be placed at each of the 54 sites defined in Project J as well as additional spring and wetland sites. Comments from the 1983 Grazing EIS (USDI 1983a) supporting the need for riparian surveys include:

- "Due to its relative scarcity (less than 5% of the total land base), water associated and riparian vegetation are very important to wildlife as habitat for feeding and reproducing."
- "Habitat for semi-wet meadow is far below potential for most semi-wet meadow primarily because of past heavy livestock use, and the subsequent invasion of annual weed species such as medusahead."
- "Important summer deer areas also include the numerous riparian areas and wet meadow habitats."
- "The riparian and upland wet meadows provide a large supply of insects and succulent forbs for young birds making them crucial habitat for both quail and brood rearing."
- "Hyatt and Howard Prairie lakes are the two main areas of significant waterfowl production on public lands within the EIS area." (USDI 1983a)

Little is known about the variability of plant composition, structure, and livestock impact to these communities within the CSNM. More detailed study of springs, seeps, isolated wetlands and riparian areas is critical since these communities occupy a small part of the landscape, but are disproportionately important to wildlife (Thomas et al. 1979, Elmore 1987). Springs, seeps, and isolated wetlands are likely to be the most highly livestock-impacted plant communities within rangelands (Lytjen et al. 2000, USDI 1983a).

Cattle are adapted to live in cool, moist environments where water is readily available. In the arid and semi-arid portions of western United States, the riparian zones provide the habitat most preferred by cattle. The availability of water, high quality forage in relative abundance, shade, and relatively flat ground make riparian zones highly attractive to cattle (Kauffman and Krueger 1984, Bryant 1982). Generally, the hotter and drier the uplands become, the more attractive riparian areas become. Thus cattle tend to concentrate their use and associated impacts in riparian zones (Roath and Krueger 1982, Bryant 1982, Kauffman and Krueger 1984).

In a 1982 study of cattle use patterns in an allotment in northeastern Oregon, Roath and Krueger found that riparian areas (as described and defined in 1982) constituted 1.9 percent of the allotment, provided 21 percent of the available forage on the allotment, and produced 81 percent of the forage actually consumed by the cattle on the allotment. Large portions of the allotment's uplands were not used at all. An improved understanding of riparian/wetland utilization by livestock is needed to ensure adequate management of these rare landscape elements.

Stubble Height as a Guideline for Range Management

Stubble height has become a commonly used variable for measuring herbage left ungrazed within riparian areas and uplands. Stubble height is easier to measure than the traditional "percent utilization" and provides a better gauge of grazing impacts to wildlife habitat within riparian areas (Clary and Leininger 2000). Knowing what is left following a period of grazing is a better indicator of cover for ground-nesting birds,

ability to trap sediments, and protect streambanks during times of high flow. While no residual stubble guides have been developed for the Monument, the literature suggests a minimum of 7 cm for high elevation systems with naturally low-statured vegetation to 15-20 cm of stubble on vulnerable streambanks, or where willows exist (Clary and Leininger 2000). These stubble heights are for sediment capture, and do not reflect the needs of wildlife for cover. Permanent transects located at sites identified by Project J will provide information on riparian use by livestock in Class I and II streams.

Smith et al (1993) suggest that ephemeral channels may be greater contributors to non-point source sediment loads. Though ephemeral streams are far less studied, it is known that riparian plants in these situations offer important structural diversity. Transects will be permanently marked along the ephemeral streams of Agate Flat to better understand this phenomenon.

Stubble height is also a useful tool in upland areas - this will be explored within the Oregon Gulch Research Natural Area, part of the landscape set aside to study natural ecosystem processes.

Plant Community Composition

Plant community data will be collected concomitant with the above stubble height study. The grazing EIS (USDI 1983a) also identifies several potential impacts of livestock (grazing and trampling) on plant community composition and structure. Impacts may vary with grazing strategy (Bock et al. 1992, Taylor 1986, USDI 1983, McMahon and Ramsy 1965). Suitably designed research objectives will answer the need for implementation monitoring (see introduction to this manuscript) as well as determine landscape pattern and levels of utilization by livestock. Abbreviated descriptions of potential livestock impacts by grazing strategy include:

Spring/Summer Grazing System: "Grazing occurs every year during the critical part of the growing season under this system. A decrease in composition of key native, upland herbaceous and woody species is expected on those areas of the allotment that receive heavy utilization - primarily areas adjacent to water developments, riparian areas, and flat valley bottoms".

Summer Grazing: "The majority of summer grazing takes place in the forested zone on logged areas. Forage is temporary in nature and is generally shaded out due to increased canopy of conifers within 20-25 years." "... as herbaceous upland species become dry in the late summer livestock begin grazing green herbaceous and shrubby species in riparian areas, and heavy utilization may occur."

Deferred rotation grazing system: "Under this system grazing would take place during the growing season until seed ripe of grass key species. Pastures would be allowed to rest every other year. At moderate grazing levels, shrub species composition is not expected to change. Concentration of livestock in riparian zones is expected to decrease because of the timing and brevity of the grazing season."

Rest Rotation Grazing System: "Rest rotation grazing alternates one or more years of complete rest with other grazing treatments. The length of the rotation cycle and number of grazing treatments depend on the number of pastures in the grazing system. The rest rotation system employed within the Monument alternates 1-1/2 to 2 months of spring or summer use grazing with one complete year of rest. This system would increase the composition of all upland and riparian key species because early spring grazing allows plants to complete regrowth and replenish carbohydrate reserves. The year of rest further ensures reproductive success and seedling survival of key species".

Exclusion: "An initial improvement in the vigor of key species would occur because the absence of grazing during the growing season would allow plants to complete vegetative growth and reproduction. Where the potential exists, a rapid increase in riparian woody species is expected".

Local thresholds of disturbance will be generated by examining patterns of species richness, weed abundance, and vegetation structure associated with seeps, springs and wetlands surveyed across the larger Monument landscape. The relation between native species richness and weed abundance associated with measured levels of disturbance [percent area surface disturbed, percent area with post holes, and percent area showing deep disturbance ("post-holing") will be examined to define possible thresholds of undesired disturbance. The above patterns will be examined within GIS to determine concurrence with soils, topography, and grazing management strategy.

Plant species compositional data will contribute to an existing classification framework (USDI 1983b). Where possible, transects placed to address the objectives of this project will be located at sites examined in the past (USDI 1983b) so as to integrate current information with past studies and to provide a historical context.

Physical Parameters

Land managers are concerned about the impact of livestock on streambanks, erosional processes, and consequences to stream cross-section. The greenline sampling protocol will be used to assess selected locations across the CSNM landscape, including exclosures spanning riparian areas.

Objectives

Objective 1: Determine the range of plant composition within springs, seeps, wetlands, and riparian areas.

Objective 2: Determine current rates of utilization (referenced to livestock exclosures and temporary exclusion cages) by livestock and residual stubble height stratified by plant life-form.

Objective 3: Determine patterns of plant species richness relative to livestock utilization (measured using percent utilization and stubble height) and degree of surface disturbance (percent soil surface disturbed; percent surface area with deep soil disturbance).

Objective 4: Determine if observed patterns of plant species richness and plant composition can be associated with the pattern of grazing strategy across the CSNM.

Objective 5: Monitor stability, current condition and long term trend of the physical aspects of riparian areas, woody and herbaceous riparian plant communities as a indication of the effectiveness of management towards meeting ecological objectives.

The following objectives are derived from the need to complete implementation monitoring of rangeland management within the CSNM:

Objective 6: Determine if the spring/summer and other grazing management strategies fit the generalized landscape of the diverse allotments and pastures of the Monument.

Objective 7: Determine if any livestock handling features fall within riparian systems.

Methods and Materials

Transects for measuring plant community composition using the same protocol as described in the livestock enclosure project will be applied to a minimum of 30% of spring, seeps, wetlands and riparian areas identified on USGS topographical maps. These transects will be conducted immediately prior to the advent of grazing to identify the range of plant community compositions within riparian communities.

The same transect lines will be repeated at the closure of the grazing season. Following tthe grazing season, stubble height measurements will be collected using guidelines from the Interagency Technical Reference (1996). Permanent transects will be located within representative wetland communities for longer-term monitoring as well as sites identified by Project J. The permanent and temporary exclosures will be used to calculate livestock utilization on a sward height basis.

Analyses

Sample adequacy

Several methods are used to assess sample adequacy. For cover data collected using a point cover intercept technique, the Interagency Technical Reference (1996) recommends plotting running average and standard deviation for a range of sample sizes bracketing the likely desired sampling rate.

Individual variable (species, growth form, or soil cover attribute)

For stubble height measurements, the Interagency Technical Reference (1996) suggests the use of confidence intervals calculated around the median value. This analysis will be stratified by plant community and life-form.

Change in composition or soil cover attributes will be measured using Chi Square contingency table analysis to test for significant change in numbers of "hits" on key species, and life-forms. This is described in greater detail within the enclosure projects section. Data will also be expressed and presented graphically as percentage cover.

Community Level

In addition to multi-variate statistical methods described previously, TWINSPAN will be used to classify plant communities, while DECORANA (Kent and Coker 1992) will be used to identify gradients of plant community composition. Canonical Correspondence Analysis (Kent and Coker 1992) will be used to elucidate relations between plant community composition and variables of interest such as percent utilization by livestock, stubble height, percent bare soil, and percent soil subjected to deep disturbance. Overlap analysis within GIS will be used to examine and quantify spatial patterns of change in plant community associated with management strategy, soils, slope, and aspect. In addition to the objectives outlined above, the data will contribute to the completion of livestock utilization mapping.

L. Range Condition

Introduction

Several government agencies have developed frameworks for assessing rangeland condition, where condition is assumed to indicate ecological integrity. Most condition frameworks within the Bureau of Land Management and Natural Resource Conservation Service are based on an approximation of how similar current plant community

composition is to the 'climax' or 'potential natural community' plant composition. Current condition may be expressed as the percent similarity to the climax composition, or categorized using terms such as early-seral, mid-seral, late-seral, and climax. Older terminology uses terms such as poor, fair, good, and excellent condition. Under older range management terminology, plant community compositions closely representing the climax composition are deemed to be in excellent condition. Condition is considered to decrease as the percent similarity to the assumed benchmark decreases. These terminologies fail to capture the difference in plant community development due to the varied forces of fire, grazing, succession, and weed invasion. Fire and grazing also vary in effect with intensity and timing of occurrence. Another reason for not using stand-level condition ratings (such as poor, fair, good, and excellent condition) is the desirability to retain a range of 'conditions' or 'seral states' representing a range of plant and wildlife habitat at the landscape-level. The monitoring plan as a whole considers different stand-level and landscape level metrics for a balanced perspective.

The Jackson County Soil Survey (USDA 1993) identifies Potential Natural Community composition by soil type. For this project, this soil and vegetation data will be used as guidance for the determination of current stand-level plant community condition/state. Current plant community data for assessing state relative to the climax condition will be derived from other projects described within this monitoring plan (Projects A, B, J, K). The major objective of this study will be the production of rangeland condition/state maps to be used in other projects and provide input to the final interpretation of livestock impact on the biological resources of the CSNM.

Objectives

Within non-transitory rangeland, create maps of rangeland condition/state based on current plant community composition (stratified by plant community) relative to the composition of the climax/potential natural community and soil condition utilizing the interagency protocol for "Interpreting Indicators of Rangeland Health (USDI 2000c)." Within transitory range, consider the percentage composition by native species compared to noxious weeds and "non-desirable" introduced species as an alternative metric. The term "non-desirable" introduced species is used to distinguish between introduced species that were used to reseed disturbed areas with the intention of stabilizing soils and providing forage for wildlife and livestock from those that are not considered noxious, but are undesirable from all other perspectives (limited use to wildlife & ability to stabilize soil, etc). An assessment of percent composition of native versus non-native species within transitory range communities will also be completed.

Methods and Materials

Condition on rangeland is determined by comparing existing vegetation on the site to the Potential Natural Community (PNC) and measurements of soil conditions. PNC is dependent on soil, climate, aspect, slope, and other environmental factors. Monitored sites are periodically compared to the assumed PNC and rated on a percentage accordingly for that vegetation type.

Early seral (poor condition) is 0 to 24 percent of climax/PNC, mid-seral (fair condition) is 25 to 49 percent of climax/PNC, and late seral (good condition) is 50 to 74 percent of climax/PNC. A site is considered at climax (excellent condition) for that site the current plant composition is above 74 percent similarity to the climax/PNC. In the past, range evaluations rated conifer forests along with standard rangelands. Since even standard rangelands in excellent condition would not approach PNC for a forested community type they would be rated lower than their actual seral state. According to the 1997 Little Butte Creek Watershed Analysis future range evaluations will be based only on monitoring non-transitory range sites. Oak woodlands, shrublands, and grasslands are

all considered non-transitory range sites. In the 1993 Soil Survey of Jackson County, Oregon each range type has a description of full Climax (100 percent PNC).

Several projects will contribute data for the assessment of rangeland condition. Plant species cover data was sampled at 97 sites in the 2000 field season to examine changes against field data collected in the past 20 years. Further compilation and analysis of these data sets is described elsewhere in this document (see Project B). Coarse plant community composition data derived from Project A (Section IV) will be analyzed using the same standards. Though older and of questionable quality, Soil and Vegetation Inventory Methods (SVIM) data collected in the early 1980s may also provide information about rangeland condition. This project examines condition relative to climax or potential natural vegetation. The final interpretation of results form all projects will consider range condition but not be limited to:

- Amount and distribution of canopy cover;
- Amount and distribution of plant litter;
- Accumulation/incorporation of organic matter;
- Amount and distribution of bare ground;
- Plant composition and community structure;
- Absence of accelerated erosion and overland flow.

Currently the 2-phase methods of determining rangeland condition (Appendix B) is used within the monument landscape. This system of condition survey will be replaced with the a more recent and comprehensive interagency protocol entitled "Interpreting Indicators of Rangeland Health (USDI 2000c)."

Analyses

Several projects and data sets will supply plant compositional data to classify study sites into the range of condition classes as described in the 'Methods and Materials'. A spreadsheet or statistical program will be used to create a similarity matrix based on the Bray Curtis Index. The resultant similarity matrix will contain comparisons of field data to the hypothetical 'climax' or 'potential natural vegetation' expressed as a percentage similarity. These percentages will be used to classify the represented sites into the condition classes identified above.

M. Rangeland Trend: Long-term Studies

Introduction

Together with the assessment of rangeland condition (Project N) and utilization (Project L), determining rangeland trend is considered critical to ensure adequate management of rangeland allotments. Trend generally refers to changes in plant community composition based on cover, frequency, or phytomass data. True trend can only be interpreted from a time series of data collected at fixed points. Apparent trend is a professional estimate of trend direction derived by examining community compositional changes along a chronosequence or seral ensemble. Such data are considered to be much less reliable than temporal data collected from fixed points. Where clear management objectives are identified (for example a 'potential natural community composition' - see project N), trend (change across time) can be assessed to be moving towards or away from the desired condition.

Intense plot-based methods for assessing rangeland trend are considered to be relevant to the site of data collection only. Since trend monitoring sites are selected to be representative of rangelands across the larger landscape, results are often extrapolated to similar plant communities on similar soils experiencing similar environmental/

management conditions (i.e., within allotments). Together with plant community maps, actual use (number of animal unit months reported by ranchers), range condition and utilization surveys help validate such extrapolations.

Several assumptions underlying the rangeland condition framework need to be described to ensure an adequate interpretation of trend:

- Trends can only be assumed to be similar in the same plant community proximal (within the allotment or pasture) to the trend site - it cannot be assumed that trend in one plant community is the same as trend in different plant community close-by.
- Livestock are uniformly distributed across the plant communities represented by trend sites.
- The successional framework on which condition is based accurately represents plant community dynamics is relevant to the plant communities of interest

While these assumptions may not be strictly met in the strict sense of the word, they need to be carefully considered before statistically validated trends are extrapolated from data collection sites to the larger landscape. This requires the professional judgement of the range manager and reliable ancillary information regarding the location of study plots relative to salt and watering sites, maps of rangeland utilization and condition, as well as the dispersion and patterning of the full range of plant communities across the landscape.

Objectives

Objective 1: Determine if there are significant changes (trends) in individual key plant frequency.

HA1.1 There are no significant changes in key species abundance [Prediction: Chi-squared analysis indicates no significant changes ($p=0.05$)]

HA1.2 There are significant changes in key species abundance [Prediction: Chi-squared analysis indicates significant changes ($p=0.05$)]

Objective 2: Describe significant changes in key species relative to range condition.

HA2.1 Rangeland trend is towards a desired condition (Prediction: there is an increase in the abundance of desired key species, and a decrease in undesired key species including weeds)

HA1.2 Rangeland trend is towards an undesired condition (Prediction: there is a decrease in the abundance of desired key species, or an increase in undesired key species including weeds)

Methods

Nested frequency is a Bureau-approved method for monitoring rangeland trend. Frequency is usually measured in plots, and can be defined as the percentage of possible plots within a sampled area occupied by the target or key species. It describes the abundance and distribution of species and is useful to detect changes in plant community over time. The change over time is expressed as trend.

Frequency is appropriate for any growth form. It is especially sensitive to changes in spatial arrangement. It may be appropriate for monitoring some annuals, whose density may vary dramatically from year to year, but whose spatial arrangement of

germination remains fairly stable. Rhizomatous species, especially grass species growing within similar vegetation, are often measured by frequency because there is no need to define a counting unit as would be the case with measurements of density. Frequency is also a good measure for monitoring invasions of undesirable species.

If the primary reason for collecting frequency data is to demonstrate that a change in vegetation has occurred, then on most sites the frequency method is capable of accomplishing the task with statistical evidence more rapidly and at less cost than any other method that is currently available (Hironaka 1985).

Another advantage of frequency over methods of measuring cover is the longer time window for sampling. Once germination has occurred frequency measurements are fairly stable throughout the growing season. Comparatively, cover measurements may change dramatically from week to week as plants grow.

The disadvantage is that frequency is a measure affected by both spatial distribution and the density of the population. Numbers obtained are dependent upon quadrat size. Therefore care must be taken to select quadrat sizes which will include an accurate representation of the plant community sampled. A further disadvantage is that frequency provides no information about structural characteristics defining habitat for plants and wildlife.

Fourteen plots are established for the seven allotments overlapping with the boundary of the CSNM. Seven of these plots fall within the actual boundary of the CSNM.

Temporal data derived from other projects (Projects B, J, K) will be examined in a similar manner to deduce trend and whether change is towards a desired condition.

Analysis

Follow the Bureau-approved protocol set forth in Rangeland Monitoring Oregon and Washington pp. 37-43 (1985). To determine if the change for key species between sampling periods is significant a Chi-Square contingency table analysis will be used.

N. Rangeland Utilization

Introduction

The proportion or degree of the current year's forage production that is consumed or destroyed by animals (including insects) is called rangeland utilization. The term may refer either to a single plant, a group of species, or to the vegetation community as a whole. Utilization is synonymous with use.

Monitoring utilization ensures in part that the management guidelines are achieved, or identify management problems subject to possible alleviation by altering the number of animal unit months, season of grazing, or moving of salt and watering points.

Current and past utilization maps will be used to describe historical and current utilization patterns within the Monument. These maps will provide spatial utilization data used in other projects described in this manuscript while also allowing an assessment of whether range management standards are achieved.

Objectives

Objective 1: Determine if current utilization within utilization plots placed to represent the larger landscape meets utilization standards (less than 60% utilization of herbaceous vegetation in upland plant communities; less than 40% utilization of woody species on upland plant communities;less than 40% utilization of herbaceous vegetation in riparian plant communities; less than 25% utilization of woody species in riparian plant communities).

Objective 2: Create maps of forage utilization to determine if utilization meets allotment wide standards and to identify possible 'hotspots' of use.

Methods and Materials

Utilization transects are completed annually on key areas using the Key Species Method (pp.81-85 Rangeland Monitoring Oregon and Washington). Key species are generally an important component of the plant community. Key species serve as indicators of change and may or may not be forage species. Key areas are indicator areas that are able to reflect utilization across the larger landscape. A key area should be a representative sample of a large stratum, such as a pasture, allotment, wildlife habitat area, herd management area, watershed area, etc. Additionally, an ocular estimation method is employed annually throughout the allotments and this information used to develop maps of utilization patterns.

Analyses

Standard analysis identified by the Interagency Technical Reference (1996) will allow statistical validation of utilization data to determine if current grazing standards are being achieved. Hand-digitizing will be used to transcribe hand-drawn utilization maps into the GIS environment. These maps will be used to determine if general allotment-wide utilization standards are achieved.

O. Photo-Monitoring

Introduction

Numerous photos documenting surveys, fence building projects, restoration efforts and other management endeavors from the mid 1970s through to the 1990s are archived at the BLM. The photos are part of the routine monitoring performed by hydrologists, range managers, fisheries biologists, wildlife biologists, and ecologists, and do not exist in a centralized collection. This project aims at duplicating images in hard-copy and digital image formats. The establishment of exact photo-location using a Global Position System (GPS) will allow easier repetition of photo-monitoring as well as the construction of local management history within GIS. The construction of a GIS based chronology of disturbance events (fire, flood, road construction, timber harvest) and livestock management in terms of grazing system (spring, summer, etc), grazing intensity, timing of grazing, proximity to watering/salting points, and grazing exclusion (as in the case of the former Box-O Ranch) will provide the necessary information for the accurate interpretation of monitoring photos.

Objectives

Objective 1: Identify photos suitable for longer-term photo-monitoring
Objective 2: Create GIS based photo-location database
Objective 3: Repeat photos suitable for long-term monitoring
Objective 4: Identify coarse plant community change in terms of increase or decrease of plant life forms (annual grass/forb, perennial grass/forb, shrub, and tree) between photo-monitoring events
Objective 5: Interpret results relative to disturbance events, by plant community, and by livestock management practices.

Methods and Materials

Existing photos will be relocated in the field using features from the photos. Time of year, time of day, weather, and photo azimuth will be replicated to facilitate comparison of photos. Positions will be accurately located using GPS technology. Once positions are imported within the GIS database for the CSNM, photos will be stratified by plant community, geographic, and management criteria as part of the photo-interpretation process. Plant community change will be assessed as increase, decrease, or no change in life-form abundance between photo-monitoring events. Where possible, these observations will be extended to individual species on a photo-by-photo basis.

Analyses

Statistical analysis is not likely for this project. In general, photos will be interpreted on a case-by-case basis, or be used to substantiate results from other projects in close proximity to photo-points. More general conclusions stratified by plant community will be made where sufficient numbers of photos exist across management or geographic boundaries. In such cases, the strength of the observations will be expressed by the percentage of photos showing similar plant community dynamics.

VI. IMPORTANT THRESHOLDS OF CHANGE

Much of the monitoring identified in this document is aimed at defining the impact of livestock on important biological objects of the monument. An interdisciplinary team representing range management, ecology (terrestrial, fish, aquatic), wildlife, and soils identified threshold values for key variables that would prompt an immediate change in livestock management. Management action may be localized or pasture-wide depending on the scope of the threshold variable. Livestock management may also be altered as a consequence of information collected from the other projects not contributing to Table 5 identifying threshold values for key variables.

VII. FINAL PROJECT INTERPRETATION

Individual projects generally provide information on several subjects including weeds, general plant community dynamics, abundance of individual species, wildlife - livestock interaction, range utilization, diverse measures of range condition, and other topics. Since the scope, intensity, and method of data collection varies between projects, it is critical to analyze data within the context of the individual project. However, a "Final Project Interpretation" will also be performed to present results by subject. This will be accompanied by a more thorough literature review than that presented within the current manuscript.

Table 5. Summary of Important Biological and Environmental Thresholds of Change prompting Management Action. (Numbers refer to enclosure/enclosure projects while letters refer to supportive studies.)

PROJECT [and parameter]	THRESHOLD	RATIONALE
1a, 1b [Plant community composition; percentage similarity]	Trend of dissimilarity between exclosures and grazed areas is greater than 10 percent while trend within exclosures includes increases in desirable plant species and/ or reduction in undesirable plant species	vegetation is a primary indicator of wildlife habitat quality. Undesirable shifts in plant community effect wildlife and overall biological diversity of native species.
1a, 1b [Key plant species: cover abundance by Idaho Fescue, willow species, alder, ash, poplar, sedges, rushes, cottonwood]	Abundance (cover) of key species inside enclosure is significantly higher than paired grazed site by greater than 5 % cover (p=0.10)	Idaho fescue = important forage species. Willow, alder, ash, poplar, cottonwood = important riparian habitat structure and food for beavers. Rush, rush, tall native perennial grasses = riparian zone hiding/nesting cover and forage species.
1a, 1b [Perennial herbaceous plant abundance: cover]	Abundance (cover) of the perennial herbaceous life-form inside enclosure is significantly higher than paired grazed site by greater than 5 % cover (p=0.10)	Perennial herbaceous plants provide long-lived roots for added bank stability, and foliage for trapping sediments
1a, 1b [Key species abundance; cover by yellow star thistle, non-native *Galium spp.*, weedy annual grasses	Abundance (cover) of key weed species outside exclosures is significantly higher than paired enclosure by greater than 5 % cover (p=0.10)	All compete with/ displace more palatable native species. Galium spp. and weedy annual grasses can cause mechanical damage to wildlife.
1a, 1b, I, J [severe surface disturbance within riparian communities]	Percent surface disturbance (cover) exceeds 10 % cover	Severe surface disturbance may lead to bank/bottom instability, loss of plant/wildlife habitat/species richness
2, E [*Calochortus greenei*: numbers of individuals]	number of individuals fall to below 90% of the initial population count in livestock impacted areas while numbers are static to increasing in livestock exclosures (p=0.10)	any decline in species for which the monument was nominated requires management action
2, E [*Calochortus greenei*: numbers of reproductive individuals]	number of reproductive individuals fall to below 90% of the initial population count in livestock impacted areas while numbers are static to increasing in livestock exclosures (p=0.10)	
3 [Nesting bird species richness]	Native nesting bird species richness is greater inside exclosures than outside	Bird species richness is an indicator of biological diversity
3 [Breeding bird species richness]	One or more species of native birds consistently found nesting inside but not outside exclosures in paired settings	Bird species richness is an indicator of biological diversity

Table 5. Summary of Important Biological and Environmental Thresholds of Change prompting Management Action. (Numbers refer to enclosure/enclosure projects while letters refer to supportive studies.)

PROJECT [and parameter]	THRESHOLD	RATIONALE
3 [Bird nesting success]	Nests outside exclosures found to be less successful (young fledged) than those inside exclosures	Nesting success is important to bird populations. Birds are important components of biological diversity
3 [Bird nest density]	Number of bird nests per acre found inside exclosures is higher than found outside exclosures.	Bird productivity is an important ecological parameter.
4 [Abundance of adult Mardon Skippers]	Numbers of adult Mardon Skippers inside enclosure is significantly higher than paired grazed site by greater than 5 % cover (p=0.10)	Mardon Skipper is a sensitive species, and reductions in populations may result in local extirpation
5 [Mollusc monitoring Mollusc numbers]	mollusc population within livestock impacted area falls below 90 % of the population within the livestock enclosure (p=0.10)	any decline in species for which the monument was nominated requires management action
5 [Mollusc monitoring temperature]	temperature in livestock impacted area is above 65°F while temperature within the enclosure remains below 65°F (p=0.10)	temperature above 65°F are lethal to aquatic molluscs
5 [Mollusc monitoring dissolved oxygen]	dissolved oxygen in livestock impacted area is less than 7.0 $mg.l^{-1}$ while dissolved oxygen within the enclosure remains above 7.0 $mg.l^{-1}$ (p=0.10)	this is the state threshold for spawning cold water fish; assume same threshold for aquatic molluscs since they also rely on gills for respiration & lay eggs in substrate
I, J Width to depth ratio[1]	Narrow floodplain (A & E channel types) = <12 Wide floodplain (B & C channel types) = >12	An inappropriately large width:depth ratio can increase stream temperature, increase fouling by algae, and decrease quality of good aquatic habitat. Bankfull stage shear stress decreases, which changes velocity and consequently induces sediment deposition. Channel widening can be caused by degrading streambanks. *Note*: In some stream channel types, downcutting and narrowing of the stream channel has the opposite and equally deleterious effect.
I, J Residual pool depth (forested streams only)[2]	Low gradient (slope <3%) or small (<7m width) = > 0.5m High gradient (slope>3%) or large (>7m width) = >1.0m	Pool depth is essential for quality fish habitat.

Table 5. Summary of Important Biological and Environmental Thresholds of Change prompting Management Action. (Numbers refer to enclosure/enclosure projects while letters refer to supportive studies.)

PROJECT [and parameter]	THRESHOLD	RATIONALE
I, J Pool frequency (forested streams only)[2]	<20 channel widths between pools	Pool frequency in an index of how well-distributed good quality habitat is throughout a stream.
I, J, K, L, O Plant community structure[3]	0% loss of woody species 0% loss of riparian-dependent plant species 0% increase in bare ground 0% decrease in willow height	Woody species (e.g. willow) protect stream banks from erosion, create cover for fish–critical in meadow areas, provide habitat for aquatic macroinvertebrates, and are an important allocthonous food source. Grasses and forbs are important for bank stabilization and trapping fine sediments during floods.
I, J, K, L, O Overhanging vegetation (within ~0.5m of water surface)[4]	Overhanging vegetation on 50% or more of the streambank, especially on outside bends.	Overhanging vegetation provides critical cover for fish, resting areas for the adult forms of aquatic insects, and important food sources for streams (with leaf fall).
I, J, K, L Shade (forested streams only)[2]	West side streams <12 m = >70% (reach average) West side streams >12 m = >60% (reach average)	Shade is critical to keep stream temperatures low and aquatic systems healthy.
K [Stubble height: minimum stubble height in riparian areas]	no stubble height measurements fall below 4 inches	stubble heights are easier to measure than percent utilization, and are more provide more information about ecosystem functioning
K [Stubble height: average stubble height in riparian areas]	the average stubble height (stratified by plant life-form and plant community) does not fall below 12 inches	
K, N [Range vegetation utilization (herbaceous component)]	utilization of key forage plants is moderate or light (less than 60%) for the uplands and light (less than 40% utilization) for riparian areas.	utilization is a good indicator of livestock use patterns. Utilization provides a measure of the effects of herbivory on plant species as it relates to plant physiological condition.
K, N [Range vegetation utilization (woody component)]	utilization of key shrubs/woody perennials measured at the end of the livestock grazing season is light (less than 40% utilization) for the uplands and less than 25% utilization for riparian areas.	

Table 5. Summary of Important Biological and Environmental Thresholds of Change prompting Management Action. (Numbers refer to enclosure/enclosure projects while letters refer to supportive studies.)

PROJECT [and parameter]	THRESHOLD	RATIONALE
M [Rangeland trend as indicated by desired key species frequency]	significant reduction in desired key species abundance [Prediction: Chi-squared analysis indicates significant changes (p=0.05)	change in frequency of key species is the conventional method for detecting trend in rangeland management
M [Rangeland trend as indicated by undesired key species frequency]	significant increase in undesired key species abundance [Prediction: Chi-squared analysis indicates significant changes (p=0.05)	

[1] Rosgen, D. 1996.

[2] Moore, K., K. Jones, and J. Dambacher. 1998.

[3] Platts, W.S. and R. L. Nelson. 1985.

[4] Leonard, S., G. Kinch, V. Elsbernd, M. Borman, and S. Swanson. 1997.

Several projects examine important variables in the context of thresholds of change. Change beyond these thresholds would identify the need for change in livestock management in terms of grazing intensity, timing or, the exclusion of grazing from part of, or the complete CSNM.

Results from landscape-level surveys may also prompt a change in livestock management. All of the studies listed in this monitoring plan will also provide information for future allotment assessments and resource management plan amendment. Some of the subjects that provide important contextual information for the interpretation of the livestock enclosure projects include:

- Plant Communities (identification, mapping, change over time);
- Weed Invasion (mapping, rate of invasion, relation to physical environment, relation to livestock utilization & management);
- Rangeland Condition [examining different perspectives of range condition (conventional BLM/SCS range condition versus alternative approaches using different benchmarks emphasizing wildlife habitat, the weed invasion process, interaction with fire, etc);
- Livestock-wildlife interaction (deer, elk, ground-nesting birds, etc.)
- Livestock impacts to springs, seeps, wetlands and other riparian plant communities
- Discussion of implementation monitoring objectives
- Discussion of effectiveness monitoring objectives

The final discussion will focus on using this knowledge to determine how livestock affect the important biological elements defined within the Presidential Proclamation of the Monument, as well as the ecosystem functioning and integrity of the larger landscape forming the context for the livestock exclosures and paired sites.

VIII. GLOSSARY OF TERMS

Allotment: An area of land designated and managed for grazing of livestock.

Analysis of Variance: A statistical algorithm intended to test whether differences between sample means of a single variable (for example, cover) are large enough to imply significant differences between population means. This is achieved by comparing within-sample-variation to between-sample-variation. The algorithm makes assumptions about random sampling, sample independence, homogeneity of variance, normality, and additivity, all of which are required to be verified to ensure test results are valid.

Animal Unit: One mature (1000 lb. (455 kg.)) cow either dry or with a calf up to six months of age.

Animal Unit Month: The amount of feed or forage (600 lb. (273 kg.)) required by one animal unit for one month.

Browse: Woody plant species consumed by animals.

Carrying Capacity: The maximum stocking rate possible year after year without causing damage to vegetation or related resources

Class 1 Stream: A system of stream classification established in the Oregon Forest practices Act. Class 1 streams are those which are significant for: a) domestic use; b) angling; c) water dependent recreation; and d) spawning, rearing, or migration of anadromous or game fish.

Class 2 Stream: All other streams that don't meet the definition of a Class 1 stream.

Crucial Habitat: Habitat that is basic to maintaining viable populations of fish or wildlife during certain seasons of the year or specific reproduction periods.

Deferred Rotation: Deferment involves delay of grazing in a pasture until the seed maturity of the key forage species. This permits the better forage species to gain vigor and reproduce. Under a deferred rotation system one pasture may be used early one year and late the next.

Enclosure: A area of approximately ˜ acre that is completely enclosed by a fence to prevent animal disturbance such as grazing. This term is synonymous with exclosure.

Exclosure: A area of approximately ˜ acre that is completely enclosed by a fence to prevent animal disturbance such as grazing. This term is synonymous with enclosure.

Forb: Herbaceous (non-woody) plants other than grasses and grass-like plants.

Grazing Capacity: The maximum stocking rate possible year after year without causing damage to vegetation or related resources

Greenup: The period of time during which plants break dormancy and put on vegetative growth.

Habitat Diversity: The relative degree or abundance of plant species, communities, habitats, or habitat features (e.g. topography, canopy layers) per unit area.

Herbaceous Plants: Non-woody plants.

Intermittent Stream: Seasonal stream. A stream that flows only at certain times of the year when it receives water from springs or from some surface source, such as melting snow in mountainous areas.

Key Species: A forage species whose use serves as an indicator to the degree of use of associated species, and because of it's importance, must be considered in any management program.

Litter: Non-decomposed dead organic matter.

Multivariate Analysis of Variance: The same as 'Analysis of Variance', but intended for more than one variable.

Pasture: An area designated to be grazed for a specified time period.

Perennial Stream: A stream that flows continuously. Perennial streams are usually associated with a water table in the localities through which they flow.

Range Condition: Departures from some conceived potential for a particular site, usually based on soil parameters and differences in vegetative species composition.

Range Improvement: An authorized physical modification or treatment which is designed to improve production of forage; change vegetation composition; control patterns of use; provide water; stabilize soil and water conditions; restore, protect, and improve the condition of rangeland ecosystems to benefit livestock, wild horses and burros, and fish and wildlife. The term includes but is not limited to structures, treatment projects, and use of mechanical devices or modifications achieved through mechanical means.

Range Trend: The direction of change over time, either towards or away from desired management objectives.

Rest: Indicates the range receives non-use for a full year rather than just during the growth period.

Rest Rotation: A grazing system where animals are moved from one pasture to another on a scheduled basis with one pasture receiving a full years rest each year.

Riparian: Riparian habitat is defined as an area of land directly influenced by permanent (surface or sub-surface) water. They have visible vegetation or physical characteristics reflective of permanent water influence. Lake shores and streams are typical riparian areas. Excluded are such sites as ephemeral streams, washes and dry gulches that do not exhibit the presence of vegetation dependent on free water in the soil.

Seral Stages: The series of relatively transitory plant communities that develop during ecological succession from bare ground to climax

Spring/Summer Grazing: Grazing that occurs during the Spring/Summer season of the year

Upland: Any area that is not considered a riparian area.

Utilization: The percentage of the current year's herbage production consumed or destroyed by herbivores.

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X. Appendices

Appendix A - Presidential Proclamation

June 9, 2000

ESTABLISHMENT OF THE CASCADE-SISKIYOU NATIONAL MONUMENT
BY THE PRESIDENT OF THE UNITED STATES OF AMERICA
A PROCLAMATION

With towering fir forests, sunlit oak groves, wildflower-strewn meadows, and steep canyons, the Cascade-Siskiyou National Monument is an ecological wonder, with biological diversity unmatched in the Cascade Range. This rich enclave of natural resources is a biological crossroads -- the interface of the Cascade, Klamath, and Siskiyou ecoregions, in an area of unique geology, biology, climate, and topography.

The monument is home to a spectacular variety of rare and beautiful species of plants and animals, whose survival in this region depends upon its continued ecological integrity. Plant communities present a rich mosaic of grass and shrublands, Garry and California black oak woodlands, juniper scablands, mixed conifer and white fir forests, and wet meadows. Stream bottoms support broad-leaf deciduous riparian trees and shrubs. Special plant communities include rosaceous chaparral and oak-juniper woodlands. The monument also contains many rare and endemic plants, such as Greene's Mariposa lily, Gentner's fritillary, and Bellinger's meadowfoam.

The monument supports an exceptional range of fauna, including one of the highest diversities of butterfly species in the United States. The Jenny Creek portion of the monument is a significant center of fresh water snail diversity, and is home to three endemic fish species, including a long-isolated stock of redband trout. The monument contains important populations of small mammals, reptile and amphibian species, and ungulates, including important winter habitat for deer. It also contains old growth habitat crucial to the threatened Northern spotted owl and numerous other bird species such as the western bluebird, the western meadowlark, the pileated woodpecker, the flammulated owl, and the pygmy nuthatch.

The monument's geology contributes substantially to its spectacular biological diversity. The majority of the monument is within the Cascade Mountain Range. The western edge of the monument lies within the older Klamath Mountain geologic province. The dynamic plate tectonics of the area, and the mixing of igneous, metamorphic, and sedimentary geological formations, have resulted in diverse lithologies and soils. Along with periods of geological isolation and a range of environmental conditions, the complex geologic history of the area has been instrumental in producing the diverse vegetative and biological richness seen today.

One of the most striking features of the Western Cascades in this area is Pilot Rock, located near the southern boundary of the monument. The rock is a volcanic plug, a remnant of a feeder vent left after a volcano eroded away, leaving an out-standing example of the inside of a volcano. Pilot Rock has sheer, vertical basalt faces up to 400 feet above the talus slope at its base, with classic columnar jointing created by the cooling of its andesite composition.

The Siskiyou Pass in the southwest comer of the monument contains portions of the Oregon/California Trail, the region's main north/south travel route first established by Native Americans in prehistoric times, and used by Peter Skene Ogden in his 1827 exploration for the Hudson's Bay Company.

Section 2 of the Act of June 8, 1906 (34 Stat. 225, 16 U.S.C. 43 1), authorizes the President, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon the lands owned or controlled by the Government of the United States to be national monuments, and to reserve as a part thereof parcels of land, the limits of which in all cases shall be confined to the smallest area compatible with the proper care and management of the objects to be protected.

WHEREAS it appears that it would be in the public interest to reserve such lands as a national monument to be known as the Cascade-Siskiyou National Monument:

NOW, THEREFORE, I, WILLIAM J. CLINTON, President of the United States of America, by the authority vested in me by section 2 of the Act of June 8, 1906 (34 Stat. 225, 16 U.S.C. 43 1), do proclaim that there are hereby set apart and reserved as the Cascade-Siskiyou National Monument, for the purpose of protecting the objects identified above, all lands and interests in lands owned or controlled by the United States within the boundaries of the area described on the map entitled "Cascade-Siskiyou National Monument" attached to and forming a part of this proclamation. The Federal land and interests in land reserved consist of approximately 52,000 acres, which is the smallest area compatible with the proper care and management of the objects to be protected.

All Federal lands and interests in lands within the boundaries of this monument are hereby appropriated and withdrawn from all forms of entry, location, selection, sale, or leasing or other disposition under the public land laws, including but not limited to withdrawal from location, entry, and patent under the mining laws, and from disposition under all laws relating to mineral and geothermal leasing, other than by exchange that furthers the protective purposes of the monument.

There is hereby reserved, as of the date of this proclamation and subject to valid existing rights, a quantity of water sufficient to fulfill the purposes for which this monument is established. Nothing in this reservation shall be construed as a relinquishment or reduction of any water use or rights reserved or appropriated by the United States on or before the date of this proclamation.

The commercial harvest of timber or other vegetative material is prohibited, except when part of an authorized science-based ecological restoration project aimed at meeting protection and old growth enhancement objectives. Any such project must be consistent with the purposes of this proclamation. No portion of the monument shall be considered to be suited for timber production, and no part of the monument shall be used in a calculation or provision of a sustained yield of timber. Removal of trees from within the monument area may take place only if clearly needed for ecological restoration and maintenance or public safety.

For the purpose of protecting the objects identified above, the Secretary of the Interior shall prohibit all motorized and mechanized vehicle use off road and shall close the Schoheim Road, except for emergency or authorized administrative purposes. Lands and interests in lands within the monument not owned by the United States shall be reserved as a part of the monument upon acquisition of title thereto by the United States.

The Secretary of the Interior shall manage the monument through the Bureau of Land Management, pursuant to applicable legal authorities (including, where applicable, the Act of August 28, 1937, as amended (43 U.S.C. 11 8 la-I 18 lj)), to implement the purposes of this proclamation.

The Secretary of the Interior shall prepare, within 3 years of this date, a management plan for this monument, and shall promulgate such regulations for its management as he deems appropriate. The management plan shall include appropriate transportation planning that addresses the actions, including road closures or travel restrictions, necessary to protect the objects identified in this proclamation.

The Secretary of the Interior shall study the impacts of livestock grazing on the objects of biological interest in the monument with specific attention to sustaining the natural ecosystem dynamics. Existing authorized permits or leases may continue with appropriate terms and conditions under existing laws and regulations. Should grazing be found incompatible with protecting the objects of biological interest, the Secretary shall retire the grazing allotments pursuant to the processes of applicable law. Should grazing permits or leases be relinquished by existing holders, the Secretary shall not reallocate the forage available under such permits or for livestock grazing purposes unless the Secretary specifically finds, pending the outcome of the study, that such reallocation will advance the purposes of the proclamation.

The establishment of this monument is subject to valid existing rights.

Nothing in this proclamation shall be deemed to enlarge or diminish the jurisdiction of the State of Oregon with respect to fish and wildlife management.

Nothing in this proclamation shall be deemed to revoke any existing withdrawal, reservation, or appropriation; however, the national monument shall be the dominant reservation.

Warning is hereby given to all unauthorized persons not to appropriate, injure, destroy, or remove any feature of this monument and not to locate or settle upon any of the lands thereof.

IN WITNESS WHEREOF, I have hereunto set my hand this ninth day of June, in the year of our Lord two thousand, and of the Independence of the United States of America the two hundred and twenty-fourth.

WILLIAM J. CLINTON

Appendix B - Monitoring Protocols

Note: This Appendix is a collection of excerpts from other goverment manuals and the references therein may not pertain to this document.

G. Point-Intercept Method - Sighting Devices, Pin Frames, and Point Frames

1. *General Description* The Point-Intercept method consists of employing a sighting device or pin/point frame along a set of transects to arrive at an estimate of cover. It measures cover for individual species, total cover, and species composition by cover.

   It is important to establish a photo plot (see Section V.A) and take both close-up and general view photographs. This allows the portrayal of resource values and conditions and furnishes visual evidence of vegetation and soil changes over time.

2. *Areas of Use* This method is suited to all vegetation types less than about 1.5 meters in height. This is because sighting devices and pin/point frames require the observer to look down on the vegetation from above in a vertical line with the ground. If the sighting device allows upward viewing, the method can also be used to estimate the canopy cover of large shrubs and trees.

3. *Advantages and Limitations* Point interception measurements are highly repeatable and lead to more precise measurements than cover estimates using quadrats. The method is more efficient than line intercept techniques, at least for herbaceous vegetation, and it is the best method of determining ground cover and the cover of the more dominant species. Given the choice between sighting devices and pin/point frames, the optical sighting device is preferable.

   A limitation of point-intercept sampling is the difficulty in picking up the minor species in the community without using a very large number of points. In addition, wind will increase the time required to complete a study because of the need to view a stationary plant.

   One limitation that is specific to the use of point frames is that a given number of points grouped in frames gives less precise estimates of cover than the same number of points distributed individually (Goodall 1952; Greig-Smith 1983). In fact, single-pin measurements require only one-third as many points as when point frames are used (Bonham 1989). Another problem with frames is that they overestimate the cover of large or clumped plants because the same plant is intercepted by different points on the same frame (Bonham 1989). This problem is overcome with the method described here by treating the frames as the sampling units (rather than using the individual points as sampling units). However, this approach doesn't change the fact that more points must be read than when the points are independent.

   Use of a pin frame device (as opposed to a grid frame made of crossing strings) will result in overestimation of cover because the pins have finite diameter. The use of a sharpened pin will greatly reduce overestimation when only the point of the pin is used to record a hit or a miss.

4. *Equipment* The following equipment is needed (see also the equipment listed in Section V.A, page 31, for the establishment of the photo plot):

   - Study Location and Documentation Data form (see Appendix A)
   - Cover Data form (see Illustration 13 on page 75)
   - Sighting device (see Illustration 15)[4]

[4] A sighting device is available commercially from ESCO, P.O. Box 18775, Boulder, Colorado 80308.

- Tripod for mounting sighting device
- Panhead for tripod (makes possible rapid positioning of sighting device)
- Pin or point frame. This can be a pin frame (see Illustration 16), usually with 10 pins (Bonham 1989; Pieper 1973) or a point frame (see Illustration 17), consisting of two superimposed string grids mounted one above the other on three adjustable legs (Floyd and Anderson 1983). The design of Floyd and Anderson (1983) produces a sighting grid of 36 points per frame.
- Hammer
- Permanent yellow or orange spray paint
- Tally counter (optional)
- Two stakes: 3/4 - or 1-inch angle iron not less than 16 inches long
- Compass
- Steel post and driver
- Tape: 50-, 100-, or 200-foot delineated in tenths and hundreds or a metric tape of the desired length.

5. *Training* A minimum of training is needed to make sure the examiners understand how to lay out baselines and transects and position and read the specific sighting device or pin/point frame being employed. The examiners must also be able to identify the plant species.

6. *Establishing Studies* Careful establishment of studies is a critical element in obtaining meaningful data.

   a Site Selection The most important factor in obtaining usable data is selecting representative areas (critical or key areas) in which to run the study (see Section II.D). Study sites should be located within a single plant community within a single ecological site. Transects and sampling points need to be randomly located within the critical or key areas (see Section III).

   b Pilot Studies Collect data on several pilot studies to determine the number of samples (transects or observation points) and the number and size of quadrats needed to collect a statistically valid sample (see Section III.B.8).

   c Study Layout Data can be collected using either the baseline or linear study designs described in Section III.A.2 beginning on page 8. The baseline technique is the recommended procedure.

   d Reference Post or Point Permanently mark the location of each study with a reference post and a study location stake (see beginning of Section III).

   e Study Identification Number studies for proper identification to ensure that the data collected can be positively associated with specific sites on the ground (see Appendix B).

   f Study Documentation Document pertinent information concerning the study on the Study Location and Documentation Data form (see beginning of Section III and Appendix A).

7. *Taking Photographs* The directions for establishing photo plots and for taking close-up and general view photographs are given in Section V.A.

8. *Sampling Process* In addition to collecting the specific studies data, general observations should be made of the study sites (see Section II.F).

a Transects Run a series of transects perpendicular to the baseline in both directions. The beginning points for each transect are randomly selected points along the baseline and the direction of each transect is also randomly determined (see Section III.A.2).

To ensure that both transects and points/point frames are independent, spacing between transects and between points/point frames on each transect should be greater than the average diameter of the largest plants likely to be sampled. (If only basal cover is to be sampled, this diameter is the basal diameter; otherwise, it is canopy diameter.)

b Sampling along Transects The first point/point frame read on each transect should be randomly determined. After the first point/point frame is read, all others are spaced the predetermined interval from the first point. If a tape is used for the transects, always read on the same side of the tape.[5]

- *Sighting Device* Determine hits by sighting through the device and recording the cover category in the cross hairs.

- *Pin/point frames* Determine hits by recording the cover category intercepted by each of the points. For pin frames, this is the cover category hit by each pin; for grid frames, this is the cover category determined by sighting through the "cross hairs" formed by each of the intersections of strings.

Hits are recorded on the Cover Data form (Illustration 13) in the following categories: vegetation (by plant species), litter, gravel, stone, and bare ground. Prior to recording data, the examiner needs to determine if canopy/foliar cover or basal cover (or both) will be recorded and if hits will be recorded in more than one canopy layer. For sighting devices and some pin/point frames, recording hits in more than one canopy layer requires that upper layers be temporarily moved out of the way to provide a direct line of sight to the lower canopy layers.

c Paired Samples If the data are to be analyzed as paired samples, each transect should be permanently marked the first year at both ends. In each subsequent year of measurement, a tape should be run from one end to the other and the points/point frames read at the selected intervals along the transect. This process should then be repeated for each transect.

d Independent Samples If the data are to be analyzed as independent samples, the transects do not have to be permanently marked. In this case, it is sufficient to pace each transect, taking measurements at each specified pace interval. The observer must ensure, however, that no bias is introduced by subconsciously "choosing" the point to be read. Such bias can be avoided by looking at the horizon when placing the tripod down.

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[5] One of the devices manufactured by ESCO employs a mounting arm that is exactly 0.5 m long from tripod pivot to the axis of point projection. With this device, two points along each transect can be read with each placement of the tripod (assuming that 1 m is the selected interval between points). If this device is used, the tripod is placed at 2 m intervals along the tape (or at a number of paces approximating 2 m if no tape is used), the arm is rotated toward the baseline, the intercepted object is recorded, the arm rotated 180°, the next intercepted object is recorded, and so on.

9. *Calculations* Make the calculations and record the results on the Cover Data form (see Illustration 13, page 75).

a Cover of Individual Plants, Litter, Gravel, Stone, and Bare Ground

(1) ***Paired samples*** Calculate the percent cover of each species along *each* transect by totaling all of the "hits" for that species along the transect, dividing the hits by the total number of points along the transect, and multiplying by 100. Calculate the total percent cover for the species in the sampled area by adding together all the transect cover values for the species and dividing by the number of transects. Do the same for litter, gravel, stone, and bare ground.

When point frames are used, the point frames themselves can be analyzed as sampling units. In this case, percent cover of each species is calculated for each point frame. Percent cover is calculated by totaling all of the "hits" for that species in one frame, dividing the hits by the total number of points in that frame, and multiplying by 100. In this situation, cover data for each frame must be recorded separately on one form or on separate forms.

(2) ***Independent samples: Sighting device and pin frames*** Calculate the percent cover of each species in the study area as a whole by totaling all the "hits" for that species along all of the transects, dividing by the total number of points in the study, and multiplying by 100. Do the same for litter, gravel, stone, and bare ground.

(3) ***Independent samples: Point frames*** For independent samples, the frames themselves can be considered the sampling units. Calculate the percent cover of each species in each point frame by totaling all the "hits" for that species in the frame, dividing the hits by the total number of points in the frame, and multiplying by 100. Calculate the total percent cover for the species in the sampled area by adding together all of the point frame cover values for the species and dividing by the number of point frames. Do the same for litter, gravel, stone, and bare ground.

(4) ***Total vegetation cover*** Calculate total vegetation cover by adding the study area cover percentages for all plant species. This total could exceed 100 percent if multiple hits (overlapping canopies) were recorded at each point along the transect.

b Species Composition Species composition is based on the percent cover of the various species. Calculate percent composition by dividing the percent cover for each plant species by the total cover for all plant species.

10. *Data Analysis* The method of data analysis depends upon whether or not the transects are permanent.

a Permanent Transects If the transects are permanent, the transects or point frames are the sampling units. Either a paired t test or the nonparametric Wilcoxon signed rank test is used to test for significant change in average cover between two sampling periods. Repeated measures analysis of variance is used to test for significant change in average cover between three or more sampling periods.

b Transects Not Permanent If the transects are not permanent, that is, if they are randomly located in each sampling period, then the samples are independent and the points can be treated as the sampling units.

Sighting Devices: Analysis consists of a Chi Square contingency table analysis to test for significant change between years in numbers of "hits" on the key species, other plant species, or cover classes.

Point Frames: Analysis consists of testing for significant changes in average cover between sampling periods using the independent sample *t* test or the nonparametric Mann Whitney U test. Independent sample analysis of variance or the nonparametric Kruskal-Wallis test is used to test for significant changes in average cover between three or more years.

11. References

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2. *Cole Browse Method* The Cole Browse Method is used to collect utilization data on browse species. This method provides data on age and form class, availability and hedging, estimated utilization, and growth and use indexes for the browse component of the plant community. These data are used to make annual utilization and trend estimates. Separate transects are run for different browse species.

a **Areas of Use** This method can be used in a wide variety of vegetation types where browse key species clearly exhibit annual leader growth.

b **Advantages and Limitations** The Cole Browse Method is more rapid than methods that require measurements; however, it is somewhat less accurate because estimates rather than measurements are used to determine utilization. There can be considerable variation in utilization estimates as well as in age and form class estimates among examiners. Plant growth characteristics, weather conditions, and site conditions may have an equal or greater influence on the appearance of plants than leader use. In addition, age class and form class may not always be sensitive indicators of the effects of browsing.

c **Equipment**

- Study Location and Documentation Data form (see Appendix A)
- Cole Browse form (see Illustration 2)
- Compass
- 10-foot tape
- Steel posts
- Post driver
- 12-inch ruler or metric equivalent

d **Training** The accuracy of utilization percentage estimates depends on the thoroughness of training. Examiners should be trained to identify browse species and to recognize annual leader growth, availability of browse, percent utilization, degree of hedging, and age class of browse plants (see Section III.D.9).

e **Establishing Studies** Careful establishment of studies is a critical element in obtaining meaningful data. Select key species and determine the number, length, and location of the transects (see Section III.B.7).

(1) Collect data using several pilot transects to determine the number of transects needed and the number of observations to be made on each transect. These data are needed to determine if a statistically valid sample has been collected (see Section III.B.7).

(2) At the beginning of each study, determine the transect bearing and distance between observation points. Select a prominent distant landmark such as a large tree, rocky point, etc., that can be used as the transect bearing point.

(3) Plot the transects on detailed management unit maps and/or aerial photos (see beginning of Section III).

(4) Permanently mark the location of each study with a reference post and study location stake (see beginning of Section III).

(5) Number studies for proper identification to ensure that the data collected can be positively associated with specific studies on the ground (see Appendix B).

(6) Document the location and other pertinent information concerning the study on the Study Location and Documentation Data form (see beginning of Section III and Appendix A).

(7) Temporary transects may be used for locating study sites or for gathering data on browse stands outside study sites. These transects do not need to be marked on the ground.

f Sampling Process Collect data beginning with the first selected plant; make the necessary observations, estimates, and measurements; and then record the data on the Cole Browse form (see Illustration 2).

(1) Sample only one species on each transect.

(2) *Form class* Observe the selected plant and check the appropriate Form Class column on the form.

(a) The form classes are as follows:

No.	Form Class
1	All available, little or no hedging
2	All available, moderately hedged
3	All available, severely hedged
4	Partially available, little or no hedging
5	Partially available, moderately hedged
6	Partially available, severely hedged
7	Unavailable
8	Dead

(b) Availability refers to browse available to the animals.

(c) The three degrees of hedging are based on the length and appearance of two-year-old wood (previous year's leaders) immediately below the current leaders (see Appendix D). If more than one degree of hedging is evident on a plant, form class is based on the predominant or average condition. The three degrees of hedging are:

Little or no hedging - Two-year-old wood is relatively long and unaltered or only slightly altered.

Moderately hedged - Two-year-old wood is fairly long but most of it has been altered from the normal growth form.

Severely hedged - Two-year-old wood is relatively short and/or strongly altered from the normal growth form.

(d) Browse plants are considered to reflect the normal growth form when less than 50 percent of the two-year-old growth (the previous year's leaders) has clipped ends and most of the current leaders extend directly from terminal buds off two-year-old wood. Alterations from the normal growth form are reflected when 50 percent or more of the two-year-old wood has clipped ends. Current leaders occur mostly as extensions from lateral buds off two-year-old wood in the moderately hedged condition or as clumped lateral and/or adventitious sprouts in severely hedged condition.

(e) The length of two-year-old wood reflects the relative vigor of the previous year's leader growth and/or the effects of prior use. Since the degrees of hedging are confined to two-year-old wood, they reflect the effects of use during a previous year, or a succession of previous years.

(f) The three degrees of hedging provide a measure of the relative condition of browse plants and help in assessing the short-term effects of different intensities of leader use.

(3) *Age class* Age class data reflect the establishment, survival, and decadence of key browse plants. Observe the selected plant and check the appropriate Age Class Column on the form. An age class designation is not made for plants in form classes 7 and 8. The four age classes are:

S - Seedling - New plants that have survived at least one growing season, but are not more than 2 or 3 years old. The basal stems are generally 1/8 inch or less in diameter.

Y - Young - Young plants usually less than 10 years old. They have an elongated growth form and simple branching with basal stems no greater than approximately .5 inch in diameter.

M - Mature - Plants more than 10 years old. They are distinguished by heavier, often gnarled stems, and complex branching. Canopy is made up of more than 50 percent living wood. Basal stems are often greater than .5 inch in diameter.

D - Decadent - Browse plants with more than 50 percent of the canopy area dead.

(4) *Leader use estimates* Leader use is an estimate of the intensity of use on browse plants available to the animals. Estimate the percent of available leaders that have been browsed on each sample plant. This estimate is based on the number of leaders that have been browsed and not on the percent of growth removed. Leader use estimates are not made for plants in form classes 7 and 8. Determine the use class that the estimate falls in and enter the class value in the Leader Use Column on the form. For example, if estimated leader use is 15 percent, then the recorded value will be 25 percent; if estimated use is 80 percent, the recorded value will be 75 percent. The leader use class percentage ranges and the corresponding class values are:

Leader Use Class Percentage Range	Class Values
0	0
1-10	5
11-40	25
41-60	50
61-90	75
91-100	95

(5) *Leader length measurements* Measure current growth on each ungrazed leader on the available portion of each sampled plant on the transect. These measurements are taken to determine the average annual growth or growth index. Record these measurements (to the nearest .5 inch or nearest centimeter) on the back of the form.

(6) *Selecting the nearest plant* To select the next plant to be sampled, face toward the transect bearing point, pace the specified distance, and then select and sample the nearest plant of the key species that occurs within a 180-degree zone (see Appendix C). Repeat this routine until the desired number of plants have been sampled. To lengthen a transect, increase the distance between observations (10 paces, 20 paces, etc.). At the end of the pacing interval, select the nearest plant in the 180-degree zone. Use the same pacing interval throughout the transect.

g Calculations Make the calculations and record the results in the appropriate column or blank on the Cole Browse form (see Illustration 2).

(1) *Form class summary* Total the number of plants in each form class and enter the value in the Total Column on the form. Calculate the percent composition by form class as follows:

$$\frac{\text{Total no. of plants in a form class}}{\text{Total no. of plants sampled}} \times 100 = \text{Percent composition by form class}$$

Enter the value in the Percent Column on the form.

(2) *Age class summary* Total the number of plants in each age class and enter the value in the Total Column on the form. Calculate percent composition by age class as follows:

$$\frac{\text{Total no. of plants in an age class}}{\text{Total no. of plants sampled}} \times 100 = \text{Percent composition by age class}$$

Enter the value in the Percent Column on the form.

(3) *Average leader use* Calculate the average leader use, being sure to exclude the number of plants that are dead or unavailable from the total number of plants sampled:

$$\frac{\text{Total estimated leader use for all plants}}{\text{Total no. of plants sampled}} = \text{Average leader use (\%)}$$

Record the value on the form.

(4) *Average leader length or growth index*

(a) The growth index is the average length of the ungrazed leaders on the sampled plants. This index can be used to compare the amounts of growth which occur in different years and as an indication of species vigor.

(b) Calculate the average leader length or growth index as follows:

$$\frac{\text{Total length of ungrazed leaders}}{\text{total no. of leaders measured}} = \text{Average length of ungrazed leaders or growth index}$$

Record the value on the form.

(5) *Use index*

(a) The use index is an indication of the volume of browse removed. This index can be used to compare amounts of browse removed in different years.

(b) Calculate the use index by multiplying the average leader use (%) times the average leader length (growth index) and dividing by 100. Record the use index on the form. For example, if average leader use is 50 percent and the average leader length is 6 inches, the use index is 3. If average leader use is 50 percent and the average leader length is 3 inches, the use index is 1.5. Although utilization is the same in both examples, twice as much browse was removed in the first example.

$$\frac{\text{Average leader use \%} \times \text{Growth index}}{100} = \text{Use index}$$

h Data Analysis Confidence intervals can be constructed around median or average leader use percentages. The number of individuals in different form and age classes can be compared to desired or expected values using Chi Square analysis.

i References

U.S. Department of Interior Bureau of Land Management. 1984. Rangeland Monitoring - Utilization Studies, TR4400-3.

Page ____ of ____

Cole Browse

Study Number	Date	Examiner

Allotment Name & Number	Pasture

Key Species	Kind and/or Class of Animal	Period of Use

Pl No	Form Class								Age Class				Leader Use -%
	1	2	3	4	5	6	7	8	S	Y	M	D	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
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18													
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24													
25													

Pl No	Form Class								Age Class				Leader Use -%
	1	2	3	4	5	6	7	8	S	Y	M	D	
26													
27													
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50													

Tot. % Form Classes

- ____ ____ 1 - All available, Little or no hedging
- ____ ____ 2 - All available, Moderately hedged
- ____ ____ 3 - All available, Severely Hedged
- ____ ____ 4 - Partially available, Little or no hedging
- ____ ____ 5 - Partially available, Moderately hedged
- ____ ____ 6 - Partially available, Severely Hedged

Subtotal

- ____ ____ 7 - Unavailable
- ____ ____ 8 - Dead

Total

Average Leader Length		Use Index	

Tot. % Age Classes Total

- ____ ____ S - Seedling, < 1/8" diam.
- ____ ____ Y - Young, 1/8" to 1/2" diam.
- ____ ____ M - Mature, > 1/2" diam.
- ____ ____ D - Decadent, 50% or more dead
- ____ ____ Total

Leader Use Class	Value	Average Leader Use
0%	0%	
1-10%	5%	
11-40%	25%	
41-60%	50%	
61-90%	75%	
91-100%	95%	

Pl No	Leader Length 1	2	3	4	5	6	7	8	9	10	Total Length	No Ldrs. Meas.	Notes (use another page, If necessary) Page 2
1													
2													
3													
4													
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43													
44													
45													
46													
47													
48													
49													
50													
										Totals			

Total Length / No Leaders Meas. = Average Leader Length _____ =

RIPARIAN AREA MANAGEMENT

Greenline Riparian-Wetland Monitoring

by

Jim Cagney
Range Conservationist
Bureau of Land Management
Grass Creek Resource Area, Wyoming

Technical Reference 1737-8
1993

U.S. Department of the Interior
Bureau of Land Management
Service Center
P.O. Box 25047
Denver, CO 80225-0047

Greenline Riparian-Wetland Monitoring

I. Introduction

Though riparian areas are not abundant in the landscape, they have great historical significance. The provide a variety of useful products, such as water, forage, and firewood. Additional values such as biological diversity, water storage, and sediment trapping have more recently been attributed to riparian areas. However the ability of a given site to provide this range of products may be dependent upon the quality of the vegetation present. For example, a stand of coyote willow will provide building materials for beaver, whereas a stand of Nebraska sedge will not. Yet the dense root mass of Nebraska sedge will provide overhanging streambanks, a key fishery habitat feature, whereas the root system of Kentucky bluegrass will not.

Modern land management plans must address these complex relationships to establish the best balance of multiple-use activities in riparian-wetland areas. Any activities in riparian-wetland areas will have an impact on the vegetation community—particularly grazing. Publications such as *Managing Grazing of Riparian Areas in the Intermountain Region* (Clary and Webster 1989); Technical Reference 1737-4, *Grazing Management in Riparian Areas* (Kinch 1989); *Managing Fisheries and Wildlife on Rangelands Grazed By Livestock* (Platts 1990); and *Effects of Cattle Grazing Systems on Willow-Dominated Plant Associations in Central Oregon* (Kovalchik and Elmore 1990) all contain a dominant theme: different grazing strategies will result in predictable changes in the vegetation community. Consequently, it is no longer valid to prescribe grazing management changes based on vague objectives such as a desire to "improve the range."

Streamside riparian areas have different vegetation production capacities based on a range of factors such as soils, hydraulic controls, or slope gradient. Technical Reference 1737-3, *Inventory and Monitoring of Riparian Areas* (Meyers 1989), contains a comprehensive list of stream segment components affecting potential plant community. Technical Reference 1737-7, *Procedures for Ecological Site Inventory* (Leonard et al. 1992), provides the basis for determining the long-term potential vegetation community associated with a given site. The greenline monitoring method can play an important role in evaluating whether site-specific riparian vegetation objectives are being met.

II. Purpose

The Bureau of Land Management's (BLM's) riparian area management policy of January 22, 1987 (USDI, 1991) contains the following statement:

> "Achieve riparian area improvement and maintenance objectives through the management of existing uses wherever feasible."

If existing conditions are not established, it will be impossible to determine if conditions are improving or being maintained. Similarly, if objectives are not established, success cannot be measured and direction is lost. BLM establishes objectives through its activity planning process. A well crafted Activity Plan provides clear direction with five essential features:

1. A description of existing conditions.
2. Measurable objectives.
3. A description of management actions designed to meet the objectives.
4. A description of how progress toward meeting objectives would be monitored.
5. A determination of how and when the plan would be evaluated.

The purpose of the greenline monitoring method is to provide riparian vegetation information suitable for use in structuring an Activity Plan as described above. The following sequence can be achieved:

1. The greenline monitoring method generates baseline data that describe existing conditions.
2. From these established existing conditions, measurable riparian vegetation objectives may be formulated.
3. The site-specific objectives provide the means for selecting a management strategy.
4. Greenline studies provide the trend data portion of the monitoring plan.
5. Rereading the data in the timeframe specified in the objectives provides the data necessary for comparative analysis in evaluating the effectiveness of the plan.

The greenline monitoring method is intended as a tool for land managers to use in analyzing riparian vegetation. It is considered an addition to, and not a replacement for, all the existing techniques currently available.

It should be noted that the greenline approach does involve one important limitation. The central data collection procedure involves a single line intercept transect. With data from a single transect or plot, statistical analysis, such as confidence intervals, cannot be computed. However the data generated are not intended as a statistical sample of the population. Rather they are a description of the transect area population itself. The transect location is carefully, as opposed to randomly, selected. Regardless, if statistical analysis is to be performed, a different data gathering procedure may need to be considered.

III. The Greenline

A. The Greenline Concept

The greenline concept is designed for measuring vegetation trends on streambanks, but can be adapted to a variety of circumstances. The method relies on identification of riparian plant community types on a line intercept transect.

Typically, a soil moisture gradient is exhibited when moving away from the channel in a riparian area. In a trend transect placed in a typical western floodplain, a different soil moisture could conceivably be encountered at each plot. Attempting to average the vegetation found in these divergent plots into a single set of data can be problematic. The greenline is a point of reference that minimizes problems associated with changing moisture gradient.

Fixed plots placed in riparian areas are vulnerable to being washed out or silted over. A greenline transect is a variable plot method that is repeatable independent of peak flow events.

B. The Greenline Definition

The greenline is defined as *that specific area where a more or less continuous cover of vegetation is encountered when moving away from the center of an observable channel.* Figure 1 is a schematic stream channel cross section illustrating the location of the greenline. When monitoring a riparian area using the greenline as a point of reference, the objective is to identify which plant communities occupy the greenline. By the definition above, a greenline would be encountered at a single point and one plant community identified. In Figure 1, the greenline on the right side of the

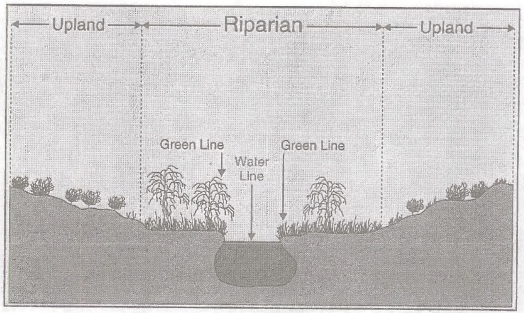

Figure 1. Stream channel cross section shows the location of the greenline.

streambank is a herbaceous vegetation community. On the left, the greenline is a shrub-dominated community with a sub-dominant herbaceous understory. When vegetation data are collected, the observer follows the greenline in a line intercept transect recording an accumulation of these points to compile a data set.

The greenline is often, but not necessarily, located at the water's edge. Areas such as unvegetated point bars are handled by following the line of vegetation behind the point bar. Vegetation growing in the channel, and islands of vegetation that do not form continuous cover, are not part of the greenline. Figures 2 and 3 are two examples of locations of the greenline along stream reaches.

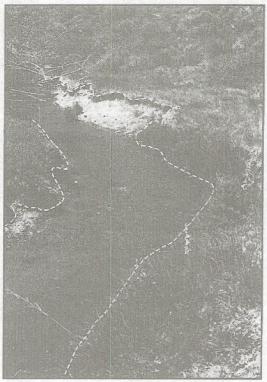

Figure 2. *Dotted line shows the location of the greenline, which follows the continuous line of vegetation along Trout Creek in southwest Wyoming.*

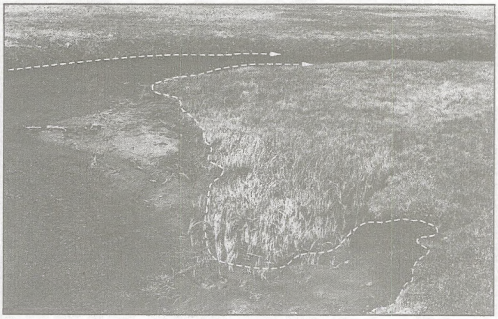

Figure 3. *Dotted line shows the location of the greenline behind a point bar in central Utah.*

IV. Riparian Community Types

One of the most dramatic differences between upland and riparian vegetation is the capacity for change with regard to both magnitude and timeframe. Barring major disturbance, such as fire, a sagebrush/bunchgrass upland plant community is relatively stable. A realistic objective would involve changes in *plant community composition* over a 30-year period. The sagebrush/bunchgrass *community type* could be expected to remain constant. In a riparian area, however, a Nebraska sedge community type could change to a Kentucky bluegrass community type in a fraction of that period. Furthermore, identification of herbaceous riparian species, one plant at a time, can be prohibitively difficult, particularly if the area has been grazed. Consequently, the greenline riparian monitoring method is designed to detect changes in plant community succession along the greenline rather than change in species composition.

The publication *Riparian Community Type Classification of Eastern Idaho-Western Wyoming* (Youngblood, Padgett, and Winward 1985) is the prototype for classifying and developing a knowledge of riparian plant communities. This document contains an established list of community types that can be determined in the field using a dichotomous key. Technical Reference 1737-5, *Riparian and Wetland Classification and Review* (Gebhardt et al. 1990), provides an overview of comprehensive riparian classifications available.

If no comprehensive community type classification is available for your area, start developing one. Riparian community types can be identified by observing dominance as a function of vegetation cover. Whatever species exhibits the most cover is what is called the community type. Community types may be defined as a single dominant or dominant/subdominant combination.

Dominant/subdominants are identified in a size class hierarchy: tree/shrub or shrub/grass (or grasslike). Community types such as Nebraska sedge with a subdominant of coyote willow, for example, are not identified. If Nebraska sedge has more canopy than willow, then the site is recorded as a Nebraska sedge community type. Herbaceous community types normally do not have subdominants, although exceptions occur. It is normal for community types to occur with several associated species as minor components.

It is important to work from a compiled list of community types prior to running a transect. Attempting to identify community types concurrent with running a transect will result in inconsistent decision making in community type identification and reduce repeatability of the data. If no local list of community types is available, the stream reach where the transect is to be run is inspected, and a field list of community types likely to be encountered along the transect is constructed. Field notes that describe associated species occurring within the community types identified should be kept, and a local list of community types observed in the planning area should be built continuously.

V. Field Procedures

The greenline monitoring method actually entails three data collection procedures designed to generate a compatible data set. Greenline composition, riparian cross-section composition, and woody species density are the data products. Based on the site-specific circumstances, it is not always necessary to collect all the data options described. For this reason the text is structured to provide a general overview of the concepts and procedure, followed by two case studies in which the concept was applied in two distinctly different ways. The example applications provide guidelines regarding installation of transects and data analysis.

A. Materials

1. Three forms entitled *Greenline Transect Data, Greenline Supplemental Data,* and *Cross-Section Composition* (see Appendix A).
2. Camera with film.
3. Six fence posts with post pounder or sledgehammer.
4. Compass.
5. Six readily visible markers; engineering pin flags work well.
6. Calculator.
7. One 6-foot rod.

Note: See the Perennial Creek Study section for a detailed description of how each of these materials are used.

B. Transect Location

The data will be most useful if a transect is located entirely within a reach of comparable potential. Within a reach, a key area location without obvious changes in factors such as slope or soils should be selected.

The greenline monitoring method is particularly useful for observing succession and trends on sites that are relatively stable. This method has the least utility in stream reaches that are rapidly changing through factors such as channel headcutting or beaver activity.

C. Recording Plant Community Data Along the Greenline

The greenline is traversed over the length of an established transect and the number of feet of each community type observed recorded on the *Greenline Transect Data* form found in Appendix A. A running tally of each community type observed is recorded, making no effort to keep track of the sequence in which the community types were observed. For example, along the greenline there may be 5 feet of a Nebraska sedge community type followed by 6 feet of coyote willow/Nebraska sedge, which in turn are followed by 8 feet of Nebraska sedge. This would be recorded as:

Nebraska sedge	5	13	ft.
Coyote willow/Nebraska sedge	6		ft.

Recording Nebraska sedge as "5, 8" with the intention to sum the total at the end is risky practice because "5, 8" can too easily become "58" when the data are analyzed.

1. Greenline Ground Rules

The following ground rules aid in collecting valid, repeatable data:

- Transects should be a minimum of 726 feet along the greenline; this distance provides an easy conversion to acreage. This length, 6 feet wide, computes to 1/10th of an acre.
- The width of the community type is not a factor when traversing a line intercept along the greenline. The objective is to identify the first community type that can be observed moving away from the center of the channel. Many factors, such as slope gradient, will determine how far this community type extends away from the channel. If the width of a community type is considered important, a line intercept cross section is run through the riparian area as a separate database as described in the Cross-Section Transects section.
- One foot is the minimum length along the transect a community type may occupy to be recorded in the database. Community types shorter than this should be combined with an adjacent community type. A 726-foot transect could be considered as 726 1-foot plots where vegetation dominance is observed.
- The vertical downward projection from the canopy determines the vegetation identified along the greenline. For example, a large cottonwood tree may dominate a site even though it is not actually rooted immediately in the greenline area.
- Community types identified do not have to be riparian vegetation; upland community types can in many cases be the vegetation occupying the greenline under the definition.
- Site-specific ground rules such as "only perennial vegetation was considered in identifying the location of the greenline" may be incorporated if documented.
- Since this method relies on the ability to step off distance accurately, it is recommended that a reliable stride be calibrated along a tape.
- Repeatability is significantly enhanced when data are reread at the same phenological stage as when the original data were collected.

2. Greenline Troubleshooting

- In some instances, a choice may have to be made between two lines of vegetation that appear to meet the greenline definition. When a site is recovering

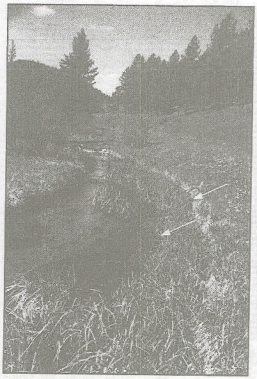

Figure 4. Arrows depict upper and lower continuous lines of vegetation along Little Spearfish Creek in western South Dakota. Since both lines are equally continuous, the lower line forms the greenline.

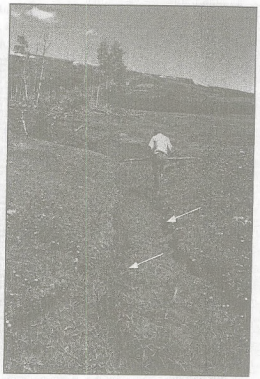

Figure 5. Arrows depict upper and lower continuous lines of vegetation along Canyon Creek in southwest Wyoming. Since the upper line is more continuous, the observer has correctly chosen the upper line as the correct greenline.

from a recent channel incision or period of heavy trampling, a new line of vegetation often begins to form at the water's edge below an old, established greenline. This can occur on a very short-term basis, such as prior to the turnout of livestock in a pasture. This common situation is illustrated in Figures 4 and 5. Consequently, a determination of which line to observe will have a pronounced effect on the database. In Figure 4, a pure stand of sedges comprises the lower line, and the upper line is a mixture of sedges, shallow-rooted grasses, and forbs. When this situation occurs, data are collected on the line that appears to be most continuous; if they appear to be about the same, the lower line is used. Figures 6 and 7 illustrate rapid movement of the greenline over a 7-year period. The data collection procedure is designed to accommodate the rapid change in stream channel morphology evident in the photographs.

- A community type titled "trample" or "barren" can be used to skip over gaps in the greenline caused by trails, etc. However, vegetation that appears trampled should be recorded whenever possible because the site will likely appear as a vegetation community type if observed during even a brief rest or deferment from grazing.

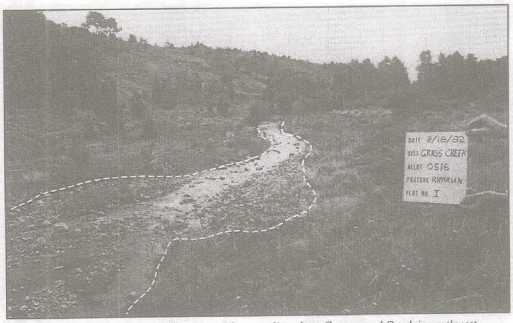

Figure 6. Dotted line shows the location of the greenline along Cottonwood Creek in northwest Wyoming, August 1982.

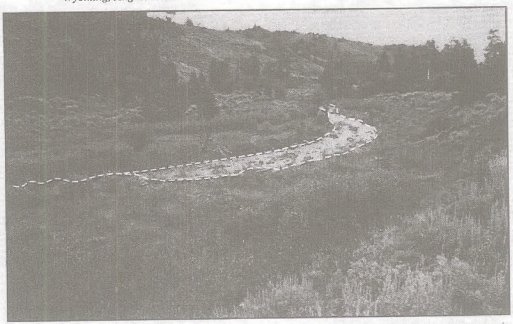

Figure 7. Dotted line shows the new location of the greenline along the same stream segment seen in Figure 6, August 1989, after vegetation growth has narrowed the channel width.

- Cut banks opposite point bars (Figure 8) and areas with slumping soils (Figure 9) present problems in identification of the greenline when unvegetated soil goes to the edge of the channel. The arrows in Figures 8 and 9 illustrate natural breaks that are commonly encountered in the greenline. When this occurs, the first option is to reconsider the site as a suitable key area. In many cases this problem can be avoided by good transect location. The second option is to follow the continuous line of vegetation behind the slump or cut, in which case the community type will normally be upland

Figure 8. *Arrow indicates where the greenline ends abruptly at a cutbank opposite a point bar along Red Canyon Creek in northwest Wyoming.*

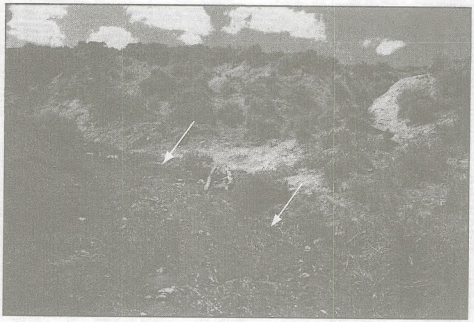

Figure 9. *Arrows show where slumping soils create breaks in the greenline along Vermillion Creek in southwest Wyoming.*

could result in too much irrelevant upland data. The third option is to follow the water's edge, where a greenline may be anticipated to form, until a normal greenline situation is reencountered.

- A "rock" or "log jam" may also be cited to skip over an unvegetated area if traversing the greenline vegetation in strict accordance with the definition would result in lower quality data.

- When special situations such as those noted above are encountered, a narrative of how the site was handled should be provided.

D. Woody Species Counts

Density of woody species is an ideal complement to greenline data. The transect is retraced while holding a 6-foot rod centered over the inside edge of the greenline. Woody species of specific concern, which are rooted in the plot formed by the 6-foot rod are counted. These data are being collected in Figure 5. Appendix A contains a *Greenline Supplemental Data* form, which is used to quantify woody species in the transect area. The form allows for the vegetation to be tallied by either age or height classes.

1. Multistemmed Species

Multistemmed species such as coyote willow or water birch are best tabulated in the following age categories:

a. Seedling - This year's growth only. Multistemmed plants such as willows exhibit only a single stem at this growth stage.

b. Young - Immature plants that appear to show more than a single season's growth. Multistemmed plants exhibit 2 to 10 stems at this stage.

c. Mature <50% Dead - Vigorous healthy plants. Multistemmed plants exhibit more than 10 stems.

d. Mature >50% Dead/Clubbed - Old declining plants; includes "mushroom" shaped willows and any plants that exhibit a clubbed appearance from long-term heavy browsing.

2. Single-Stemmed Species

Single-stemmed species such as cottonwood are best tabulated in height classes: 0 to 3 feet, >3 to 6 feet, >6 to 10 feet, and over 10 feet. It is common to encounter trees in atypical form as a result of flood events, etc. These trees are tallied at the height they occur on the day observed. For example, if a 30-foot tree has been knocked down but remains alive, the tallest part on the day observed may be the 5-foot height of a lower branch.

3. Woody Species Ground Rules

The following ground rules and tips aid in collecting valid, repeatable data:

- The rod is centered on the greenline in order to detect reproduction on point bars between the greenline and the water's edge. Generally, where no point bars are encountered, half of the rod hangs out over the stream channel. When

observing narrow streams, only those plants associated with the bank being traversed are recorded in order to avoid counting plants twice.

- On some transects, seedlings or young plants may be too numerous to readily count. It is sufficient to note this in lieu of a tally count.

- Identification of individual plants can be difficult, as some judgement is required to differentiate between an individual plant and a sprout or stem. If it cannot be reasonably assumed that two stems share a common root without excavating soil, the two should be tallied as individuals.

- Dead plants are ignored on woody counts.

E. Cross-Section Transects

Appendix A contains a *Cross-Section Composition* form used to record the plant community composition of a riparian area in general. To collect these data, a line intercept transect is run perpendicular to the riparian area, and data are recorded in the same manner as described in the Recording Data Along the Greenline section. The data form is designed to record three cross-section transects. In some areas, up to five cross-section transects may be desirable. In such cases, a second form can be used. See the Perennial Creek Study section for more information regarding cross-section transects.

F. Photopoints

Photopoints provide an excellent record in both interpreting the data and aiding in repeatability. Pictures are taken to show both the transect location and the data collected. The *Greenline Supplemental Data* form (Appendix A) contains a place to record the content of photos taken.

B. Residue Measuring Methods

1. *Stubble Height Method* The concept of this method is to measure stubble height, or height (in centimeters or inches) of herbage left ungrazed at any given time. This method, because of its simple application, is becoming a well-accepted method for expressing rangeland use.

   This method would be used after stubble height standards for specific plant communities had been developed. As an example, a stubble height of 4 inches might be specified to provide streambank protection, to trap sediments, and to rebuild degraded stream channels in riparian areas.

   a **Areas of Use** Stubble height standards and measurements have been used primarily in riparian areas; however, this method may also be used for upland sites. Adequate stubble height on streamside areas is needed at the end of the growing season for maintenance of plant vigor and streambank protection.

   b **Advantages and Disadvantages** Stubble height measurements are simple, quick, and accurate. This method can be used to monitor large areas in less time than is needed with traditional utilization study methods. Statistical reliability improves because numerous measurements can be taken in a relatively short time. Limitations of the method may stem from infrequent application in a variety of rangeland ecosystems. While stubble height has been used with great success in riparian areas, there needs to be more research in a variety of other plant communities.

   c **Equipment**

   - Study Location and Documentation Data form (see Appendix A)
   - Stubble Height form (see Illustration 4)
   - Tape measure

   d **Training** Minimal training of examiners is needed to use this method. Examiners must be able to identify the plant species. This method requires measuring stubble heights of selected key species, which can easily be accomplished by agency personnel, permittees, or other interested individuals.

   e **Establishing Studies** Careful establishment of studies is a critical element in obtaining meaningful data. Select key species and determine the number, length, and location of the transects (see Section III.B.7). Document the location and other pertinent information concerning transects on the Stubble Height form.

      (1) Collect data using several pilot transects to determine the number of transects needed and the number of observations to be made on each transect. These data are needed to determine if a statistically valid sample has been collected (see Section III.B.7).

      (2) At the beginning of each study, determine the transect bearing and distance between observation points. Select a prominent distant landmark such as a large tree, rocky point, etc., that can be used as the transect bearing point.

(3) Plot the transects on detailed management unit maps and/or aerial photos (see beginning of Section III).

(4) Permanently mark the location of each study with a reference post and study location stake (see beginning of Section III).

(5) Number studies for proper identification to ensure that the data collected can be positively associated with specific studies on the ground (see Appendix B).

(6) Document the location and other pertinent information concerning the study on the Study Location and Documentation Data form (see beginning of Section III and Appendix A).

f **Sampling Process** At specified intervals, measure the stubble height of the key species nearest to the toe of the right foot and record on the Stubble Height form (Illustration 4). Measurements should be in inches or centimeters of leaf stubble left. For riparian sites, sampling should be done along both sides of a stream segment. For upland sites and wet meadow riparian sites, measurements should be taken along a predetermined course or transect. In either situation, stubble height data can be collected using the linear or baseline techniques described in Section III.A.2.

g **Calculations** Use data from the Stubble Height form for calculating the average stubble height by species.

h **Data Analysis** Confidence levels should be calculated for the median. See Interagency Technical Reference, *Planning for Monitoring*, for information on determining confidence intervals.

i **References**

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Page ____ of ____

Stubble Height

Study Number	Date	Examiner
Allotment Name & Number	Pasture	

	1	2	3	4	5	6
Site (or)						
Species						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Total						
Average						

(Record averages on back of form.)

Stubble Height Summary			
Species	Total Stubble Height	Number of Plants	Average Stubble Height
Totals			

Notes:

B. Frequency Methods - Pace Frequency, Quadrat Frequency, and Nested Frequency Methods

1. *General Description* All three methods consist of observing quadrats along transects, with quadrats systematically located at specified intervals along each transect. The only differences in these technique are the size and configuration of the quadrat frames and the layout of the transect. The following vegetation attributes are monitored with this method:

   - Frequency
   - Basal cover and general cover categories (including litter)
   - Reproduction of key species (if seedling data are collected)

   It is important to establish a photo plot (see Section V.A) and take both close-up and general view photographs. This allows the portrayal of resource values and conditions and furnishes visual evidence of vegetation and soil changes over time.

2. *Areas of Use* This method is applicable to a wide variety of vegetation types and is suited for use with grasses, forbs, and shrubs.

3. *Advantages and Limitations*

   a Frequency sampling is highly objective, repeatable, rapid, and simple to perform, and it involves a minimum number of decisions. Decisions are limited to identifying species and determining whether or not species are rooted within the quadrats (presence or absence).

   b Frequency data can be collected in different-sized quadrats with the use of the nested frame. When a plant of a particular species occurs within a plot, it also occurs in all of the successively larger plots. Frequency of occurrence for various size plots can be analyzed even though frequency is recorded for only one size plot. This eliminates problems with comparing frequency data from different plot sizes. Use of the nested plot configuration improves the chance of selecting a proper size plot for frequency sampling.

   c Cover data can also be collected at the same time frequency data is gathered. However, cover data collected in this manner will greatly overestimate cover; unless the tines are honed to a fine point, observer bias will come into play. Another limitation is that the use of one size quadrat will likely result in values falling outside the optimum frequency range (greater than 20 percent to less than 80 percent) for some of the species of interest.

4. *Equipment* The following equipment is needed (see also the equipment list in Section V.A, page 31, for the establishment of the photo plot):

   - Study Location and Documentation Data form (see Appendix A)
   - Frequency form (see Illustration 4)
   - Nested Frequency form (see Illustration 5)
   - Permanent yellow or orange spray paint
   - Frequency frames (see Illustrations 6 and 7)

- One transect location stake: 3/4 - or 1-inch angle iron not less than 16 inches long
- Hammer
- Tally counter (optional)
- Compass
- Steel post and driver
- Tape: 50-, 100-, or 200-foot delineated in tenths and hundreds or a metric tape of the desired length.

5. *Training* A minimum amount of training is needed for this method. Examiners must be able to identify the plant species and be able to tell whether or not a species occurs, according to study specifications, within a quadrat. Examiners must be familiar with the cover categories and how to collect cover data using the tines on the quadrat frame.

6. *Establishing Studies* Careful establishment of studies is a critical element in obtaining meaningful data (see Section III).

   a Site Selection The most important factor in obtaining usable data is selecting representative areas (critical or key areas) in which to run the study (see Sections II.D). Study sites should be located within a single plant community within a single ecological site. Transects and sampling points need to be randomly located within the critical or key areas (see Section III).

   b Pilot Studies Collect data on several pilot studies to determine the number of samples (transects or observation points) and the number and size of quadrats needed to collect a statistically valid sample (see Section III.B.8).

   c Selecting Quadrat Size The selection of quadrat size is important and depends on the characteristics of the vegetation to be sampled (see Section III.B.6).

      (1) As a rule of thumb, it is expected that all frequency percentages for important species should fall between 10 and 90 percent or, if possible, between 20 and 80 percent. This will provide the greatest possible chance for detecting an important trend for a species when the study is read again. Use a frame size that will produce frequencies falling in this range for the greatest number of species possible.

      (2) To build a sample frame, see Illustration 6, which shows an example of a frequency frame.

      (3) Use the same size quadrat throughout a study and for rereading the study. If frequencies for a specific species approach the extremes of either 0 or 100 percent, it may be necessary to use a different sized quadrat for that species. The nested plot concept would be suitable in this instance.

   d Nested Plot Technique The use of one size plot is usually not adequate to collect frequency data on all the important species within a community. For each species occurring on a site, there is a limited range of plot sizes capable of producing frequency percentages between 20 and 80 percent. A plot size appropriate for one species may not be appropriate for another. The nested plot

concept is a simple approach to collecting data on two or more different sized plots at one time. Several different sized plots are placed inside each other in a smallest to largest sequence (see Illustration 7).

e **Number of Studies** Establish at least one frequency study on each study site; establish more if needed (see Sections II.D and III.B).

f **Study Layout** Frequency data can be collected using either the baseline, macroplot, or linear study designs described in Section III.A.2 beginning on page 8. The baseline technique is the one most often used.

Align a tape (100-, or 200-foot, or metric equivalent) in a straight line by stretching it between the baseline beginning stake and the baseline end point stake (see Figure 4 on page 13.) A pin may also be driven into the ground at the midpoint of the transect. Do not allow vegetation to deflect the alignment of the tape. A spring and pulley may be useful to help maintain a straight line.

With the baseline technique, any number of transects can be run perpendicularly to the baseline, depending on the intensity of the sample needed (see Figure 1 on page 9). Each transect originates at a randomly selected mark along the baseline. The randomization is restricted so that half of the transects are randomized on each side of the halfway mark. (Directions for randomly selecting the location of transects to be run off of a baseline using random number tables are given in Appendix D.)

The starting point for each transect off the base line and the distance between each quadrat should not be any closer than the width of the quadrat being used to avoid the possibility that any two quadrats might overlap.

g **Reference Post or Point** Permanently mark the location of each study with a reference post and study location stake (see beginning of Section III).

h **Study Identification** Number studies for proper identification to ensure that the data collected can be positively associated with specific studies on the ground (see Appendix B).

i **Study Documentation** Document pertinent information concerning the study on the Study Location and Documentation Data form (see beginning of Section III and Appendix A).

7. *Taking Photographs* The directions for establishing photo plots and for taking close-up and general view photographs are given in Section V.A.

8. *Sampling Process* In addition to collecting the specific study data, general observations should be made of the study sites (see Section II.F).

a **Running the Transect** Study data are collected along several transects. The location of each transect (distance along the baseline) and the direction (to left or right from the baseline) are randomly determined for each study site. A quadrat is read at the specified interval until all quadrats have been read. The interval between quadrats can be either paced or measured. To widen the area

transected, add additional paces or distance (20 paces, 50 feet) between quadrats. Additional transects can be added to obtain an adequate sample.

(1) Start each transect by placing the rear corner of the quadrat frame at the starting point along the baseline tape.

(2) Place the quadrat frame at the designated interval along a transect perpendicular to the baseline until the specified number of quadrats have been read. The interval between quadrats can be measured or estimated by pacing.

(3) When a transect is completed, move to the next starting point on the baseline tape and run the next transect.

b **Collecting Cover Data** Record, by dot count tally, the cover category at each of the four corners and at the tip of any tines on the frame. Enter this data in the Cover Summary section of the Frequency and Nested Frequency forms (see Illustrations 4 and 5). The cover categories are bare ground (gravel less than 1/12 inch in diameter is tallied as bare ground), litter, and gravel (1/12 inch and larger). Additional cover categories can be added as needed. Vegetation is recorded as basal hits or canopy layers in the bottom portion of the form. Up to three canopy layers can be recorded. For additional information on collecting vegetation cover data, see Section V.F.8.b on page 72. Cover data can also be recorded on the Cover Data form, Illustration 13, page 75.

Read the same points on the frame and the same number of points at each placement of the frame throughout a study and when rereading that study.

c **Collecting Frequency Data** Collect frequency data for all plant species. Record the data by species within each quadrat using the Frequency form (Illustration 4). Only one record is made for each species per quadrat, regardless of the number of individual plants of a species that occurs within the quadrat.

(1) Herbaceous plants (grasses and forbs) must be rooted in the quadrat to be counted.

(2) On many occasions, rooted frequency on trees and shrubs (including half shrubs) does not provide an adequate sample (occurring within 20% of the plots). To increase the sample size on trees and shrubs, the canopy overhanging the quadrat can be counted.

(3) Annual plants are counted whether green or dried.

(4) Specimens of the plants that are unknown should be collected and marked for later identification.

(5) Frequency occurrence of seedlings by plant species should be tallied separately from mature plants.

d **Nested Plot Method** Collect frequency data for all plant species. For uniformity in recording data, the four nested plots in a quadrat are numbered from 1 through 4, with the largest plot size corresponding with the higher number. Each time the quadrat frame is placed on the ground, determine the smallest size plot each species occurs in and record the plot number for that quadrat on the Nested Frequency form (Illustration 5).

9. *Calculations* Make the calculations and record the results in the appropriate columns on the Frequency form (see Illustration 4).

a **Cover** Calculate the percent cover for each cover category by dividing the number of hits for each category by the total number of hits for all categories, including hits on vegetation, and multiplying the value by 100. The total of the percent cover for all cover categories equals 100 percent. Additional information on calculating ground cover, canopy cover, and basal cover can be found in Section F.9 on page 73.

b **Frequency: Single Plot** On the Frequency form, Illustration 4, total the frequency hits by species. Calculate the percent frequency for each plant species by dividing the total number of hits for that species by the total number of quadrats sampled along the transect and multiplying the value by 100. Record the percent frequency on the form.

c **Frequency: Nested Plot** Percent frequency by species can be calculated for each transect and/or for the total of all transects.

(1) ***Compiling data*** Determine the number of occurrences for each species for each plot size.

(a) Count the number of occurrences of a species in plot 1 and record the value in the Hits portion of column 1 in the Frequency Summary portion of the Nested Frequency form (see Illustration 5).

(b) Count the number of occurrences of the same species in plot 2 and add this number to the number recorded for plot 1. Record this total in the Hits portion of column 2.

(c) Count the number of occurrences of the same species in plot 3 and add this number to the number recorded for plot 2. Record this total in the Hits portion of column 3.

(d) Count the number of occurrences of the same species in plot 4 and add this number to the number recorded for plot 3. Record this total in the Hits portion of column 4.

(2) ***Frequency for each transect*** Calculate the percent frequency of a plant species by plot size for a transect by dividing the number of occurrences by the number of quadrats sampled and multiplying the value by 100. Record in the "% Freq" section of the Frequency Summary portion.

(3) *Total frequency for all transects* Calculate the percent frequency of a plant species by plot size for the total of all transects by adding the occurrences of a species by plot size on all transects, dividing the total by the total number of quadrats sampled for the study, and multiplying the value by 100. Record the percent frequency in the appropriate plot size on a separate form.

10. *Data Analysis* To determine if the change between sampling periods is significant, a Chi Square contingency table analysis should be used (see the Interagency Technical Reference, *Planning for Monitoring*). Frequency must be analyzed separately for each species. Chi Square analysis of variance can also be used to detect changes in cover classes between sampling periods.

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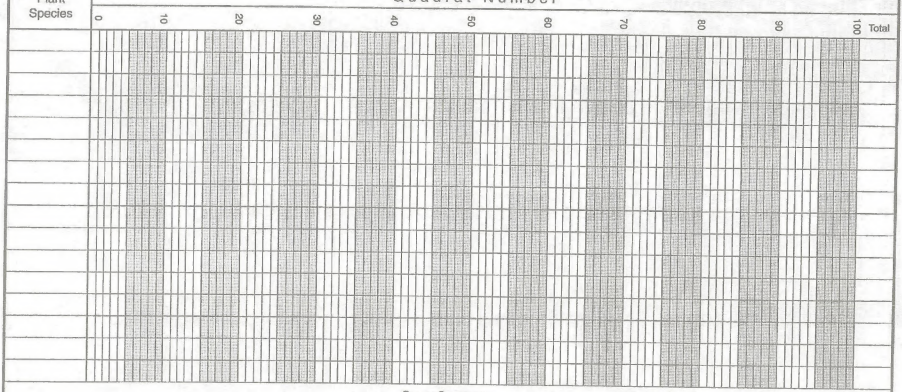
Frequency

Page____of____

Study Number	Date	Examiner	Allotment Name & Number	Pasture
Transect Location		Number of Quadrats		Quadrat Size



Cover Summary

Vegetation (Basal)		Vegetation (Canopy)		Litter		Bare Ground		Gravel/Stone			
Hits	%Cover	Hits	%Cover	Hits	%Cover	Hits	%Cover	Hits	%Cover	Hits	%Cover

Notes (use other side or another page)

Nested Frequency

Page____of____

Study Number	Date	Examiner	Allotment Name & Number	Pasture

Transect Location	Number of Quadrats	Quadrat Size

Plant Species	Quadrats																				Frequency Summary by Plot Size								Cover Summary
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1		2		3		4		
																					Hits	% Freq	Hits	% Freq	Hits	% Freq	Hits	% Freq	
																													Vegetation (Basal)
																													Hits %Cover
																													Vegetation (Canopy)
																													Hits %Cover
																													Litter
																													Hits %Cover
																													Bare Ground
																													Hits %Cover
																													Gravel/Stone
																													Hits %Cover
																													Crytogamic crust
																													Hits %Cover

Observations/Comments

Notes (Use other side or another page)

Canopy* Dont record ground cover under canopy hits of shrubs under 10ft in height

RIPARIAN SURVEY FORMS AND PROCEDURES

1. Riparian Vegetative Communities
2. Habitat Diverstiy Index
3. Remarks
4. Condition
5. Trend
6. Species List
7. Horizontal - Vertical Vegetation Distribution
8. Step-point
9. Sketch of Stream Section
10. Examples of forms

To gather similar data from all sites and facilitate summarizing data, standard forms are utilized. The following contains samples of each form and a brief explanation of its use and, for some, a more detailed explanation of meaning and values.

1. Riparian Vegetative Community

   This is the basic form for obtaining stream vegetation data. It contains spaces for species and foliar cover, location, and various parameters pertinent to this community which set it apart from others. The spaces are self-explanatory.

2. Habitat Diversity Index System

   The Habitat Diversity Index (HDI) is one that incorporates most of the basic premises of wildlife habitat management. It can be used to measure the ability of a habitat site to provide food, cover, and reproductive requirements for a species or a group of species. It deals with the number of potential niches available for expected species richness and can be used graphically to predict the presence of a "feature" species or group of species on the site. The data used in calculating the Habitat Diversity Indices (HDI's) can be used in determining limiting factors for a species or group of species for a selected habitat site. The system employs data in such a manner that the loss or gain in species richness or relative abundance of a select species due to a management action (i.e. timber harvest) can be predicted.

   Most of the data required to calculate the HDI's can be obtained from the range management portion of the Soil-Vegetation Inventory Method (SVIM) effort. There need not be any duplication of effort. If SVIM data is not available, an HDI for a standard habitat site can be calculated with minimum field time (approximately 30-45 minutes). Additional sampling may require more time due to the complexity of the site or the severity of proposed action, but for the majority of cases it is not necessary. In certain western Oregon districts where no SVIM data is yet available, timber management systems such as the Operation Inventory (O.I.) or Timber Production Class Capability can be used in part.

   The HDI system is basically used to record the physical attributes of a standard habitat site and then calculate the potential use by wildlife species of that site. The greater the HDI, the more probable that a greater number of species (species richness) use that site for their life needs because of the greater "opportunities" available.

   The habitat diversity indices were calculated for each habitat site based on information on the following parameters: plant species present (plant forms i.e. grass, shrub, trees), vertical and horizontal spatial distribution of plant species present, presence of rocks greater than ten inches diameter and the presence of persistent litter.

   Sites were evaluated on the following criteria:

   a. Plant Forms

      A numerical value for plant forms is assigned based on the presence or absense of the various plant forms. A value of two points was assigned

for growth forms having greater than 2% foliar cover. An optional one point value could be assigned if the plant form was present along the site but comprised less than 2% folier cover.

The plant form categories are: Submergents/emergents, sedges/rushes, grasses, forbs, upright shrubs, hardwood trees, and conifers.

Example:	POPR		PEFR$_5$		BENE$_2$	(Species)
	Grass		Forb		Upright Shrub	(Veg. Type)
	2	+	2	+	2	= 6 Points

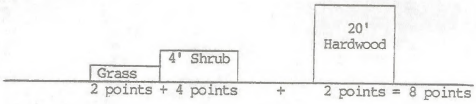
If all plant forms are present, a value of 14 points is assigned.

b. Edges

Edges are present spatially both vertically and horizontally, each is considered separately. Vertical edges are assigned a point value if the growth form (grass and/or forbs) or height group is present.

The vertical edge categories are: Grass/forb, four feet, four to fifteen feet, fifteen to forty-five feet, forty-five to ninety feet, and ninety feet and above. Each category is valued at two points except the four feet high which is four points. These are based on ocular observations.

Example:

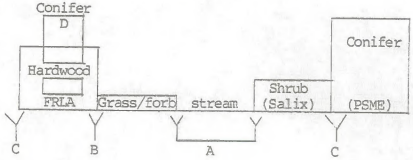


Fourteen points possible if all vertical layers represented.

Horizontal edges are present when different growth forms grow side by side. Each growth form abutting another growth form has a value of two points. The horizontal edge categories are:

streamside	shrub: hardwood
grass/forb: shrub	shrub: conifer
grass/forb: hardwood	hardwood: conifer
grass/forb: conifer	riparian: upland

Example:



Streamside = 2 points (A)
Riparian: upland = 2 points (C) = 8 points
Grass/forb: hardwood = 2 points (B)
Hardwood: conifer = 2 points (D)

Sixteen points possible if all potentials are present.

c. Water Availability

The water availability categories are based on seasonal or perennial surface flows. Point values are the perennial streams six points, intermittent streams four points, and seasonal streams two points. Since a stream is generally only one of the above, a maximum of six points is assigned.

d. Unique Habitats

Unique habitats are generally small in comparison to the overall habitat, but unique in nature. Each unique habitat was assigned a value of one point. Examples of unique habitats are:

cliffs	Gravelbar greater than 50' long
talus slope	beaver pond(s)
cave	thick streamside grass cover
spring	stable cutbank greater than 8' high
cattails	

e. Riparian Zone Condition

The value of the condition of the riparian zone is reflected in the points for each condition class. The condition classes and point values are:

Excellent	6 points
Good	4 points
Fair	2 points
Poor	0 points

Points from one category only will be assigned.

f. Width of Riparian Zone

The width of the combined sides of the riparian zone are assigned point values by width classes. The width classes and their point values are:

0-20 feet	2 points
20-40 feet	4 points
40 feet or wider	6 points

Only one category may be utilized, that which fits the average riparian zone width.

g. Snags

Snags are grouped by height and DBH into two groups: less than six feet tall and less than eleven inches DBH and greater than six feet tall and eleven inches DBH. Point values are assigned by the number of snags per acre in each size class. If both size classes are present, only the larger value is assigned. One additional point is assigned if both conifer and hardwood snags are present.

Point values for group of snags are:

Number of Snags Per Acre	Less than 6' tall & less than 11" DBH	Greater than 6' tall & greater than 11" DBH
1 - 3	1 point	2 points
3 or more	2 points	3 points

Estimates are by ocular calculation. A maximum of four points is allowed.

The Habitat Diversity Index equals the sum of the component sections, A through G, above. Low HDI values represent habitats with little diversity. High HDI's represent habitats with high diversity and complexities.

3. Remarks by Quarter Mile

This page explains itself well. It is for any notes not covered in the field forms. It may be utilized as a place for a narrative of the site. The items recorded may include any from the list above or any other pertinent information such as a special habitat feature.

Include: management of adjacent habitat, type of adjacent habitat; character of stream channel; continuity of habitat, bank conditions, layers, etc.; tributaries and springs, seepages and size; snags, number and size, location of clumped; cliffs, rock outcroppings, or any other special feature; any type of irregularity of difference in the type of habitat or expansion of points in main section.

4. Riparian Zone Condition

The evaluation of the condition includes five aspects (see Rating Form and Criteria Sheet). The two primary are vegetation age and composition, and bank condition. These two are rated for all streams. The secondary three; logging, grazing, and roads are rated only as they apply. The rating system is a sliding scale of 0-20 (15) points for each aspect considered. The closer to excellent condition, the higher the score or rating.

If an area has been logged and had a detrimental effect on the stream, then 20 points are added to the total possible points and the appropriate deductions made from that total possible. Depending on the activities affecting a stream, the points may or may not be added. For example, if a riparian zone had been previously logged and had recovered from that logging, yet was rated in fair condition due to other influences, then logging points would not be added. This is because the design of the rating system would ultimately increase the condition of the stream rather than decrease it.

Therefore, the rating may have 40, 60, 80, or 100 points possible depending on the riparian zone use. The assigned points are taken as a percentage of the total possible which equates to condition.

5. Observed Apparent Trend

The evaluation of the trend involves four primary observations and one secondary. The first four are plant, vigor, seedling establishment, vegetation composition, and surface litter (see rating and criteria forms). These are rated on all streams riparian zones. The secondary value of pedestalling is rated only if pedestalling is present. If present, the value of damage from fifteen possible points is subtracted from the total of the primary factors. This value gives a rating relative to the changing complexity of the area.

The vegetation composition is also examined under the condition rating. They are, however looking for different factors relating to composition and rated at different values.

6. The wildlife observed section is a space for recording the sighting of animals, tracks, scat or calls that indicate presence.

7. The Horizontal-Vertical Distribution (H/V Dist)

The horizontal-vertical distribution (H/V Dist) drawings graphically show a two-dimensional outline of existing woody vegetation. It is useful for defining layers and serves as a record for the future. Photographs were taken at many of the sites and in some cases served as the H/V distribution record.

8. The Step-Point Transect

The Step-Point Transect is a method of gathering data about species composition at the various canopy levels. Estimates of foliar cover may frequently exceed 100% due to overlapping forage layers. The step-point demonstrates that layering and provides raw data for percentages of each canopy, species or ground cover types. The step-point is a selection method with an imaginary line from your toe through all canopy layers. Any plant touching that line is registered on the step point form in its proper canopy layer. Generally, 50 one-meter steps were registered for each bank of the stream, and a perpendicular transect was run from the stream to the outer edge of the riparian zone, for each side.

9. Sketch of Stream

A sketch of the stream section surveyed was drawn during the 1981 and 1982 surveys. These are useful for recording features of the stream or riparian zone such as cutbanks, waterfalls, groups of snags, etc.

FORM # 1

RIPARIAN VEGETATIVE COMMUNITY

GRASSES & GRASSLIKE	% PRESENT	
MOSS		
FORBS		
SHRUBS		
TREES		

STREAM ______________ CLASS ______

T ____ R ____ S ____ MILE ______

Resource area ______ tenths ______

DATE ______________ PHOTO ______

EXAMINERS __________/__________

PLANT COMMUNITY ______________

CANOPY COVER $\bar{X}$ ______ % (______ TO ______)

CLUMPED ______ EVEN ______

STREAM GRADIENT $\bar{X}$ ______ % (______ TO ______)

STREAM WIDTH $\bar{X}$ ______ (______ TO ______)

STREAM DEPTH $\bar{X}$ ______ (______ TO ______)

BANK SLOPE: RIGHT $\bar{X}$ ______ % (______ TO ______)

LEFT $\bar{X}$ ______ % (______ TO ______)

RIPARIAN ZONE WIDTH

RIGHT $\bar{X}$ ______ (______ TO ______)

LEFT $\bar{X}$ ______ (______ TO ______)

STREAMBED COMPOSITION silt sand gravel cobblestone boulder bedrock

ELEVATION ______

ACRES ______

SWA # ______

CHANNEL WIDTH $\bar{X}$ ______ (______ TO ______)

Temperature: TIME ______ H_2O ______ AMB ______

FORM # 2

HABITAT DIVERSITY INDEX

PLANT FORMS

emergents/submergents	2	___
sedges/rushes	2	___
grasses	2	___
forbs	2	___
upright shrubs	2	___
hardwood trees	2	___
conifers	2	___
Total Points		___

EDGES

Vertical layers		
grasses/forbs	2	___
4 ft.	4	___
4 - 15 ft.	2	___
15 - 45 ft.	2	___
45 - 90 ft.	2	___
90 ft. and above	2	___
Total points		___
Horizontal layers		
streamside	2	___
grass/forb:shrub	2	___
grass/forb:hardwood	2	___
grass/forb:conifer	2	___
shrubs:hardwood	2	___
shrubs:conifer	2	___
hardwood:conifer	2	___
riparian:upland	2	___
Total points		___

WATER AVAILABILITY

perrennial	6	___
intermittent	4	___
seasonal	2	___
Total points		___

UNIQUE HABITATS 1 point ea.

cliff	___
talus slope	___
cave	___
stable cut bank .8 ft high +	___
gravel bar 50 ft long +	___
beaver pond	___
thick grass cover at streamside	___
spring	___
cattails	___
other....	___
Total points	___

RIPARIAN ZONE CONDITION

excellent	6	___
good	4	___
fair	2	___
poor	0	
Total points		___

WIDTH OF RIPARIAN ZONE

0 - 20 ft.	2	___
20- 40 ft.	4	___
40 ft. or wider	6	___
Total points		___

SNAGS

#/acre	6' tall 11" DBH	6' tall 11" DE
1-3	1 point	2 points
3+	2 points	3 points
both hardwood and conifer snags		1 point

Total points ___

HDI total _____

FORM #

4. RIPARIAN ZONE CONDITION

PARAMETER	POINTS POSSIBLE	POINTS ASSIGNED	
Vegetation age and composition	0-20	_____	80 - 100 excellent
Bank condition	0-20	_____	55 - 79 good
Grazing impacts	0-20 n/a	_____	30 - 54 fair
Logging impacts	0-20 n/a	_____	0 - 29 poor
Roads and/or crossings	0-20 n/a	_____	
TOTALS		_____	

points assigned _____ X 100 = _____ % of possible

points possible _____

5. OBSERVED APPARENT TREND

	Points	
Plant vigor	_____	51 - 75 upward
Seedling establishment	_____	
Vegetative composition	_____	26 - 50 static
Surface litter	_____	
Pedestalling	_____	0 - 25 downward
TOTAL	_____	

6. WILDLIFE OBSERVED

AVIAN SPECIES MAMMALIAN SPECIES HERPTILES AND FISH

CRITERIA FOR FORM # 4

CRITERIA FORM

STREAM RIPARIAN ZONE CONDITION EVALUATION

80 - 100% excellent
55 - 79 good
30 - 54 fair
0 - 29 poor

VEGETATION AGE AND COMPOSITION

16 - 20 Desirable trees and shrubs numerous, mature and immature stages present. Grasses and forbs vigorous and common.

11 - 15 All age classes of trees and shrubs, fewer mature trees, seedlings common. Grasses and forbs present, minor disturbances revegetating well.

6 - 10 Moderate numbers of trees and shrubs, mostly single age class. Grasses and forbs present, including invader species.

0 - 5 Trees and shrubs few and/or decadent, single age class, few seedlings present. Many invader species present.

BANK CONDITIONS

16 - 20 Bank stable, failures rare; gullies, if present, in stable condition.

11 - 15 Bank failure and slumps uncommon and small, adequately revegetated; gullies, if present, with some active erosion.

6 - 10 Occasional bank failure, some severe; root mats disturbed; gullies well developed with moderate erosion.

0 - 5 Bank sloughing common, erosion and siltation evident; gullies deep, V-shaped, and activity eroding.

GRAZING IMPACTS (at date of evaluation)

16 - 20 Trails few, not eroding; minimal grazing, less than 10% new growth (current grazing season).

11 - 15 Trails not eroding; moderate grazing/browsing, less than 30% new growth.

6 - 10 Frequent cattle trails, compaction, trampling and erosion light to moderate; 30 to 50% browsing/grazing of new gorwth; moderate pedastaling.

0 - 5 Trails increasing runoff and erosion; heavy browsing/grazing, greater than 50% of new growth; moderate to heavy pedastaling.

LOGGING IMPACTS

16 - 20 None, logging greater than 100m from stream.

11 - 15 Logging to stream, hardwoods and shrubs remain, occasional siltation.

6 - 10 Some vegetation remains after logging, debris in stream, siltation present

0 - 5 Debris in stream, silt jams, no buffer eroding banks common.

PARALLEL ROADS AND/OR CROSSINGS

16 - 20 Minimal effect or limited to parallel roads some distance from stream, or a single crossing that is fully revegetated.

11 - 15 Occasional minor slough from road bank; areas previously impacted have recovered; crossings infrequent, mostly revegetated.

6 - 10 Light to moderate erosion of road cuts and crossings; some revegetation, limits riparian zone width, not directly adjacent to stream.

0 - 5 Moderate to severe erosion of road cuts; limits width of zone; little vegetative cover.

CRITERIA FOR FORM # 5

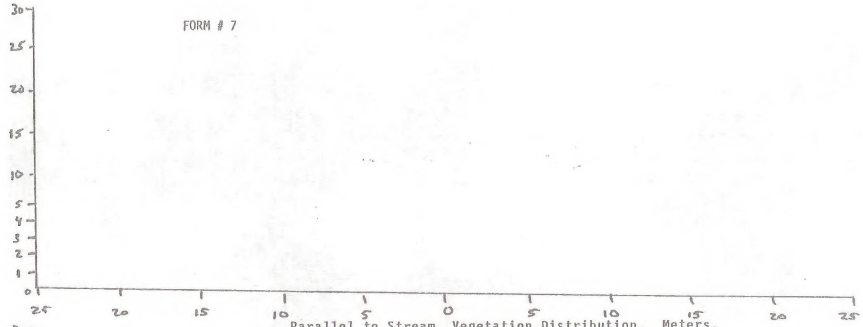
51 - 75 upward
26 - 50 static
0 - 25 downward

CRITERIA SHEET

OBSERVED APPARENT TREND

	POINTS	PLANT VIGOR
	16-20	Desirable grasses forbs and shrubs vigorous, showing good size and color and producing abundant herbage.
	11-15	Desirable grasses, forbs, and shrubs have moderate vigor. Medium size, fair color, and producing moderate amounts of herbage. Some seedstalks present.
A	6-10	Some increaser and invader species present. Desirable vegetation has low vigor, with small size and poor color. Some plants dead or partially dead. Few seedstalks or seedheads present.
	0- 5	Increaser and invader species abundant. Few desirables remain and many are dead or dying.
		SEEDLINGS
	16-20	Abundant seedling establishment of desirable vegetation. Most age classes represented by vegetation. Few seedlings or invaders or increasers.
	11-15	Moderate seedling establishment of desirable plants. Some age classes
B		represented. Some invader and increaser seedlings present.
	6-10	Few seedlings or desirable vegetation and few age classes represented. Many increaser and invader species present.
	0- 5	Mostly seedlings of invaders or increasers present. Mostly a single age class.
		VEGETATION COMPOSITION
	16-20	Riparian vegetation highly diverse with many vertical layers represented. Good woody plant development. 80-100% canopy cover.
	11-15	Vegetation moderately diverse with at least 3-4 vertical layers represented.
C		Woody vegetation common. 65-79% canopy cover.
	6-10	Fair diversity with at lease 2-3 vertical layers. Some woody vegetation 40-64% canopy cover.
	0- 5	Little diversity with only one or two levels. Woody vegetation scarce or absent. Less than 40% canopy cover.
		SURFACE LITTER
	11-15	Surface litter is plentiful and continuing to accumulate.
D	6-10	Moderate movement of surface litter is apparent and deposited against obstacles.
	0- 5	Very little surface litter remaining.
	Total A+B+C+D	Subtract points taken from E if E applicable
		PEDESTALS
	11-15	There is little visual evidence of pedestalling. Those pedestals present are sloping or rounded and accumulating litter; desirable forage grasses may be found along edges of pedestals.
E	6-10	Moderate plant pedestalling. No visual evidence of healing or deterioration. All rock and plant pedestals may be occuring in flow patterns.
	0- 5	Most rocks and plants are pedestalled. Pedestals are sharp, wide, and eroding often exposing grass roots.

FORM # 7


30
25
20
15
10
5
4
3
2
1
0
25 20 15 10 5 0 5 10 15 20 25
Parallel to Stream, Vegetation Distribution. Meters.
30
25
20
15
10
5
4
3
2
1
0
PSME
FRLA
TABR
ACMA
SPDO
SPDO
BEAO
2 3 4 5 6 7 8 9 10
Perpendicular to Stream, Vegetation Distribution. Meters.

FORM # 8

STEP POINT DATA

Stream:
Mile:
T.____ R.____ Sec.____ Date

Left Bank Aspect:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
							ERLA													
							SPDO													
C1							POPR													
GRD							B													
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
C3																				
C2																				
C1																				
GRD																				

	41	42	43	44	45	46	47	48	49	50
C3										
C2										
C1										
GRD										

Left Bank Aspect:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C3																				
C2																				
C1																				
GRD																				
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
C3																				
C2																				
C1																				
GRD																				

	41	42	43	44	45	46	47	48	49	50
C3										
C2										
C1										
GRD										

Examiners_____

RANGE CONDITION CRITERIA FOR TWO PHASE METHOD SURVEYS PHASE I - FORAGE STAND INDEX RATINGS (Revised March 1957)

QUALITY: Judge proportionate relationship of plants composing the stand which are respectively of high forage value, of intermediate forage value, of low forage value and worthless for forage. Local lists of plants so classified are essential.

25 - Outstanding predominance in the proportion of high quality perennial forage plants in the stand. Remainder of the stand is composed principally of medium value, with the percentage of either low value or worthless plants negligible.

20 - At least half of the stand is composed of high quality perennial forage plants. Remainder of the stand is mostly medium value plants, with minor percentages of low value and few worthless plants. (High quality annual plants may be considered here if they persist and are available for use throughout the grazing season.)

15 - At least one-third of the perennial forage plants are of high quality. Medium value plants may be predominant. Low quality and/or worthless plants may not exceed one-third of the stand. (Annual plants of high and medium quality but short-lived usefulness are considered here.)

10 - High quality perennial forage plants are few. A major proportion of the forage plants are of medium and low value. Worthless plants comprise a significant percentage of the stand. (Annual plants of medium and low value and with short life are considered here.)

5 - Outstanding preponderance in proportion of low value and/or worthless forage plants in the stand. (These may be either annuals or perennials.) Remaining percentage of stand is principally composed of inferior or medium value plants. High quality plants are negligible or relics.

****

0 - An extreme situation where only low value or worthless plants for forage comprise the stand.

QUANTITY: Considering the site and environmental potentials for production of vegetation, judge the relative density of stand and degree of occupancy of available space by <u>valuable and desirable</u> forage plants, (i.e. high and medium values on lists).

25 - There is a very dense stand of valuable and desirable forage plants. Such plants occupy the available space almost exclusively.

20 - There is a thick stand in density of valuable and desirable forage plants. There may be minor amounts of space occupied by undesirable and worthless forage plants.

15 - There is a medium stand in density of valuable and desirable plants. Low value plants and/or those worthless for forage may be equally dense or occupy equal space with the desirable plants.

10 - There is a thin, open, or patchy stand of valuable and desirable plants. Low value and/or Worthless plants may be denser or occupy a major portion of the available space.

5 - There is a scanty and widely-spaced stand of valuable and desirable plants. There may be dense stands of low value and worthless plants.

****

0 - An extreme situation - there is no appreciable density of valuable and desirable plants. Space occupancy is almost entirely by worthless plants.

VIGOR: Judge the relative degree of health and thrift of the **valuable and desirable forage plants**. This is evidenced by their size, height, shape, color, firmness of rooting, amount of leafage or shoot production and flower or seed stalk abundance. Consider adversely comparative vigor of competing undesirable plants.

25 - Valuable and desirable plants are robust, of maximum height and excellent color, well formed and producing abundant leafage, seed stalks and shoots. They are firmly rooted and show no sign of weakness or malformation.

20 - Valuable and desirable plants are thrifty and of good height, shape and color. Grass clumps or sods are intact and well filled. Shrubs are sturdy, with good form and moderate numbers and length of shoots.

15 - Valuable and desirable plants are of medium size, fair height, and with a medium volume of leafage and shoot production. Grass clumps may be small or sods patchy. Shrubs may have relatively fewer and shorter shoots or may be somewhat distorted in form.

10 - Valuable and desirable plants are low or short poorly formed and unthrifty. Leafage and shoot production is limited. Grass clumps may have dead centers, sod formations may be broken and irregular. Shrubs are malformed or scrawny.

5 - Valuable and desirable plants are critically weak and decadent with poor color, stunted form, and with very limited leafage or shoot production. Grass tufts or shrubs often are infirmly rooted or pedestaled.

****

0 - Extreme situation - valuable and desirable plants are barely existing relics, or dying.

REPRODUCTION: Judge the comparative abundance and evidence of survival of seedlings, and younger age classes of the **valuable and desirable forage plants**. Usually these are in competition with low value and worthless plants for future increases and replacements in the stand.

25 - Reproduction of valuable and desirable plants is abundant. It is outstandingly predominant in all younger age classes and seedlings. This indicates the constant presence of sufficient reproduction to build or maintain dominance of the better forage plants.

20 - Reproduction of valuable and desirable plants is frequent and in the majority with respect to most new seedlings and younger age classes. Some low value or worthless plant reproduction is present in minor amounts or in the older age classes of reproduction.

15 - Reproduction of valuable and desirable plants occurs in near equal amounts and frequency with that of low value or worthless plants.

10 - Reproduction of valuable and desirable plants is scanty. It is in the minority in most younger age classes and may be overshadowed by of low value and worthless plants.

5 - Reproduction of valuable and desirable plants is rare or negligible in amount. That of low value or worthless plants is usually predominant in all younger age classes. This indicates that the undesirable plants are definitely and dominantly in control of the stand.

****

0 - Extreme situation - no evidence that valuable and desirable plants are reproducing and surviving in the stand.

Phase II - SITE AND SOIL MANTLE INDEX RATING

PROTECTIVE COVER: Judge the relative density and mass effectiveness of the cover formed by all kinds of vegetation, including litter, shrubs, and trees, which shields the soil mantle from disturbance by water and wind. Note the size and pattern of bare spaces.

25 - Dense cover making a full and continuous canopy over the surface of the ground. It affords maximum protection against erosion by water or wind.

20 - A thick cover in which there may be some small and widely spaced openings. Usually it affords good protection against erosive forces, but the nature of cover and dispersion of plants or litter leaves some marginal openings bare.

15 - A medium cover of vegetation, or a thick cover with large and patchy openings; or open stands of "annuals" or "perennials" which persist to maintain cover. These are moderately or partially effective as protection against erosive forces.

10 - A thin cover of vegetation, or litter, or ephemeral and short-lived annual plants, or scattered clumps and islands of vegetation in large bare openings. These are only slightly effective against erosive forces.

5 - Widely dispersed and scanty cover of vegetation and litter, or annual vegetation that vanishes quickly or appears only in some years. Ineffective against erosive forces as most of the ground surface is uncovered most of the time.

****

0 - Extreme cases - barren of cover or nearly so.

NATURAL VULNERABILITY: Judge comparatively the natural features of terrain and environment which tend either to accelerate or reduce the force and effectiveness of wind and water as erosion agents. Such features would include position and land form and position, topographic relief, slope and exposure; the nature and properties of the soils; surface stoniness or outcrops, and characteristic extremes of local weather. Consider these under presently prevailing conditions of cover and climate. The rating should reflect vulnerability to whichever erosion agent is most active locally.

25 - Minimum erosion hazard from either water or wind because of natural feature. For water this usually means valleys, plains or terraces, gentle gradients, smooth terrain, and stable and absorptive soils. For wind action this usually means broken or rugged terrain and stable soils.

20 - Slight erosion hazard from either water or wind because of natural features. For water this usually means some hilly or rolling terrain with moderate slopes, and fairly stable and absorptive soils. For wind this usually means undulating or rough topography with few level areas subject to wind sweep.

15 - Moderate erosion hazard from all erosive forces because of natural features. Intermediate conditions of terrain relief and steepness of slope. Moderately stable and absorptive soils.

10 - High erosion hazard from either water or wind because of natural features. For water this usually means relatively steep slopes, dissected terrain, rather unstable soils, and sharply cut water courses. For wind this means much smooth topography which offers little protection from wind sweep, and loose or light soils.

5 - Critical erosion hazard from either water or wind because of natural features. For water this usually means precipitous slopes, badland areas of shale or bare rock exposure, and disintegrating types of soils. For wind this usually means flat smooth terrain with little obstruction to wind sweep, and light or loose soils easily subject to blowing.

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0 - Extreme situation as bare rock, exposed subsoil layers, or active dunes.

SURFACE RUNOFF: Judge comparatively the rapidity with which water from snowmelt or rainfall enters the soil or runs off over the soil surface and in drainageways or stream courses. Consider the nature, amount and time of occurrence of all forms of precipitation.

25 - No or very slight indication of surface runoff occurrence. Most of the water from snow or rain is apparently absorbed or moves so gradually that litter and soil are practically undisturbed. Drainageways and stream courses are smoothly rounded and apparently well stabilized.

20 - Some evidence that a small amount of surface runoff occurs. There is some disturbance of litter, fine soil, and small debris but these are carried only short distances and moved in zigzag patterns. Water courses and drainageways are fairly stable though well defined.

15 - There are marks of moderate amounts of over-surface flow occurring, indicating lessened absorption and percolation. Litter movement and soil or debris lodgment behind obstacles is common but in irregular patterns. Drainageways show evidence of high water flow and debris deposits and some cutting of streambanks is evident.

10 - Many indications of rapid runoff, low absorption, and a large volume of over-surface flow. Straight rill gully patterns may show on exposed slopes, drainages will show evidence of instability and active bank cutting or deepening. Litter accumulation is sparse. Stream courses show silt, and debris deposits intermittently or at high water stage levels of overflow plains.

5 - Much evidence of occurrence of quick runoff and torrential or flood flows of waters. There is no litter accumulation in place. Gully patterns are incised on slops. Flood debris and coarse rubble deposits occur along watercourse banks and as fans at stream junctions. Watercourse channels are commonly straight walled and deeply sunk in valley floors.

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0 - Extreme situation - evidence of floods of great volume carried in thoroughly scoured channels.

SOIL STABILITY: Judge comparatively the present rate of erosional activity by the degree of soil disturbance or movement. Results of either wind or water action or both should be considered.

25 - Soil mantle is intact with no evidence of soil movement. The soil is accumulating in place with no sign of transportation. Surface litter is usually accumulating in place.

20 - Slight evidence of some recent soil movement. There may be limited movement of fine soil from bare ground or on certain exposures, but generally stable surface conditions prevail.

15 - Moderate movement of soil is plainly apparent and recent. There may be some terracing, or occasional plants on pedestals, or a few small rill gullies in exposed places. Some sediment deposits occur intermittently in runoff channels or against small obstructions elsewhere. Some gravel is exposed in bare spots where fine soil has been removed.

10 - Well advanced and active soil erosion is evident. Usually there are active gullies to aid soil carriage and plants are on pedestals of soil. Drifted soil or debris deposits are very noticeable against minor surface obstructions. Drainageways show silty deposits or sandy material along channels or in fans. Erosion pavement is well formed on gravelly or stony soil, but the pattern is open. Transported soil appears about shrub clumps.

5 - Severe soil erosion: There is exposed subsoil, closed erosion pavement on stony soils, many active and frequent gullies, sharply incised drainage channels, large fan deposits of soil and debris which includes gravel and rocks. There are wind scoured depressions and active wind cutting or embryonic dunes in sandy situations.

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0 - Extreme situation - as on barren badlands, or shifting sand dunes.

Form 4--1529
(July 1960)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TWO-PHASE RANGE CONDITION FIELD RECORD

State & District

Unit or Allotment

Examiner

Date

PRESENT USE BY Kind of Livestock	Numbers	Season From	Season To	Stocking Rate (AUMs)
				( )

TRAVERSE ROUTE

PRESENT RANGE RESOURCE CONDITION INDEX

	1	2	3	4	5
LOCATION TIE *					
DESCRIPTION OF TYPE Name--Number List of Principal Species					
DESCRIPTION OF SITE Land Form Topography Exposure Soil Moisture					
FORAGE STAND Total & (Trend)	( )	( )	( )	( )	( )
Quality Quantity Vigor Reproduction					
SITE--SOIL MANTLE Total & (Trend)	( )	( )	( )	( )	( )
Protective Cover Vulnerability Runoff Resistance Soil Stability					
TWO-PHASE RATING					

* Identify each writeup station by Section, Township, Range, or by landmark features

74

SUPPLEMENTAL INFORMATION

PRESENT RANGE RESOURCE CONDITION INDEX

LOCATION TIE*					
DESCRIPTION OF TYPE Name--Number List of Principal Species	(6)	(7)	(8)	(9)	(10)
DESCRIPTION OF SITE Land Form Topography Exposure Soil Moisture					
FORAGE STAND Total % (Trend)	( )	( )	( )	( )	( )
Quality Quantity Vigor Reproduction					
SITE-SOIL MANTLE Total % (Trend)	( )	( )	( )	( )	( )
Protective Cover Vulnerability Runoff Resistance Soil Stability					
TWO-PHASE RATING					

UNIT OR ALLOTMENT SUMMARY

Area: Gross _____ Alienated _____ Federal Range _____
(Acres)

Federal Range Unusable _____ Game Use Only _____ Usable by livestock _____

Condition Classification *(Usable Federal Range)*: _____ Acres

(Acres) Excellent _____ Good _____ Fair _____ Poor _____ Bad _____

Percent, Each Class: _____ _____ _____ _____

Trend: Improving _____ Static or Indefinite _____ Declining _____

Percent _____ _____ _____

Appendix C - Rangeland Management Standards and Guidelines

MEMORANDUM

To:The Secretary

Through: Bob Armstrong
Assistant Secretary, Land and Minerals Management

From:Director, Bureau of Land Management

Subject: Approval of Oregon/Washington Standards and Guidelines

In accordance with 43 CFR 4180.2(b), the Bureau of Land Management Oregon State Director is submitting the attached Standards for Rangeland Health and Guidelines for Grazing Management for public lands administered in Oregon and Washington for Secretarial approval. The standards and guidelines have been reviewed by the Departmental Review Team who found that they comply with the requirements of the regulations. The standards and guidelines were developed with full public participation and in consultation with Oregon/Washington's resource advisory councils and are in conformance with the appropriate land use plans.

I recommend that you approve the Oregon/Washington Standards for Rangeland Health and Guidelines for Grazing Management.

I concur with your recommendation and approve the Oregon/Washington Standards for Rangeland Health and Guidelines for Grazing Management for immediate implementation.

Approved by: Bruce Babbitt
Date August 12, 1997

Table of Contents

Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington

Introduction

These Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington were developed in consultation with Resource Advisory Councils and Provincial Advisory Committees, tribes and others. These standards and guidelines meet the requirements and intent of 43 Code of Federal Regulations, Subpart 4180 (Rangeland Health) and are to be used as presented, in their entirety. These standards and guidelines are intended to provide a clear statement of agency policy and direction for those who use public lands for livestock grazing, and for those who are responsible for their management and accountable for their condition. Nothing in this document should be interpreted as an abrogation of Federal trust responsibilities in protection of treaty rights of Indian tribes or any other statutory responsibilities including, but not limited to, the Taylor Grazing Act, the Clean Water Act, and the Endangered Species Act.

Fundamentals of Rangeland Health

The objectives of the rangeland health regulations referred to above are: "to promote healthy sustainable rangeland ecosystems; to accelerate restoration and improvement of public rangelands to properly functioning conditions; ... and to provide for the sustainability of the western livestock industry and communities that are dependent upon productive, healthy public rangelands."

To help meet these objectives, the regulations on rangeland health identify fundamental principles providing direction to the States, districts, and on-the-ground public land managers and users in the management and use of rangeland ecosystems.

A hierarchy, or order, of ecological function and process exists within each ecosystem. The rangeland ecosystem consists of four primary, interactive components: a physical component, a biological component, a social component, and an economic component. This perspective implies that the physical function of an ecosystem supports the biological health, diversity and productivity of that system. In turn, the interaction of the physical and biological components of the ecosystem provides the basic needs of society and supports economic use and potential.

The Fundamentals of Rangeland Health stated in 43 CFR 41 80 are:

1. Watersheds are in, or are making significant progress toward, properly functioning physical condition, including their upland, riparian-wetland, and aquatic components; soil and plant conditions support infiltration, soil moisture storage and the release of water that are in balance with climate and landform and maintain or improve water quality, water quantity and the timing and duration of flow.

2. Ecological processes, including the hydrologic cycle, nutrient cycle and energy flow, are maintained, or there is significant progress toward their attainment, in order to support healthy biotic populations and communities.

3. Water quality complies with State water quality standards and achieves, or is making significant progress toward achieving, established Bureau of Land Management objectives such as meeting wildlife needs.

Standards for Rangeland Health

The standards for rangeland health (standards), based on the above fundamentals, are expressions of the physical and biological condition or degree of function necessary to sustain healthy rangeland ecosystems. Although the focus of these standards is on domestic livestock grazing on Bureau of Land Management lands, on-the-ground decisions must consider the effects and impacts of all uses.

Standards that address the physical components of rangeland ecosystems focus on the roles and interactions of geology and landform, soil, climate and water as they govern watershed function and soil stability. The biological components addressed in the standards focus on the roles and interactions of plants, animals and microbes (producers, consumers and decomposers), and their habitats in the ecosystem. The biological component of rangeland ecosystems is supported by physical function of the system, and it is recognized that biological activity also influences and supports many of the ecosystem's physical functions.

Guidance contained in 43 CFR 4180 of the regulations directs management toward the maintenance or restoration of the physical function and biological health of rangeland ecosystems. Focusing on the basic ecological health and function of rangelands is expected to provide for the maintenance, enhancement, or creation of future social and economic options.

The standards are based upon the ecological potential and capability of each site. In assessing a site's condition or degree of function, it must be understood that the evaluation compares each site to its own potential or capability. Potential and capability are defined as follows:

> **Potential-**The highest level of condition or degree of function a site can attain given no political, social or economic constraints.
>
> **Capability-**The highest level of condition or degree of function a site can attain given certain political, social or economic constraints. For example, these constraints might include riparian areas permanently occupied by a highway or railroad bed that prevent the stream's full access to its original flood plain. If such constraints are removed, the site may be able to move toward its potential.

In designing and implementing management strategies to meet the standards of rangeland health, the potential of the site must be identified, and any constraints recognized, in order that plan goals and objectives are realistic and physically and economically achievable.

Standards and Guidelines in Relation to the Planning Process

The standards apply to the goals of land use plans, activity-plans, and project plans (Allotment Management Plans, Annual Operating Plans, Habitat Management Plans, etc.). They establish the physical and biological conditions or degree of function toward which management of publicly owned rangeland is to be directed. In the development of a plan, direction provided by the standards and the social and economic needs expressed by local communities and individuals are brought together in formulating the goal(s) of that plan.When the standards and the social and economic goals of the planning participants are woven together in the plan goal(s), the quantifiable, time specific objectives) of the plan are then developed. Objectives describe and quantify the desired future conditions to be achieved within a specified time frame. Each plan objective should address the physical, biological, social and economic elements identified in the plan goal.Standards apply to all ecological sites and land forms on public rangelands throughout Oregon and Washington. The standards require site-specific information for full on-ground usability. For each standard, a set of indicators is identified for use in tailoring the standards to site-specific situations. These indicators are used for rangeland ecosystem assessments and monitoring and for developing terms and conditions for permits and leases that achieve the plan goal.

Guidelines for livestock grazing management offer guidance in achieving the plan goal and objectives. The guidelines outline practices, methods, techniques and considerations used to ensure that progress is achieved in a way, and at a rate, that meets the plan goal and objectives.

Indicators of Rangeland Health

The condition or degree of function of a site in relation to the standards and its trend toward or away from any standard is determined through the use of reliable and scientifically sound indicators. The consistent application of such indicators can provide an objective view of the condition and trend of a site when used by trained observers. For example, the amount and distribution of ground cover can be used to indicate that infiltration at the soil surface can take place as described in the standard relating to upland watershed function. In applying this indicator, the specific levels of plant cover necessary to support infiltration in a particular soil should be identified using currently available information from reference areas, if they exist; from technical sources like soil survey reports, Ecological Site Inventories, and Ecological Site Descriptions, or from other existing reference materials. Reference areas are lands that best represent the potential of a specific ecological site in both physical function and biological health. In many instances potential reference areas are identified in Ecological Site Descriptions and are referred to as "type locations." In the absence of suitable reference areas, the selection of indicators to be used in measuring or judging condition or function should be made by an interdisciplinary team of experienced professionals and other trained individuals.

Not all indicators identified for each standard are expected to be employed in every situation. Criteria for selecting appropriate indicators and methods of measurement and observation include, but are not limited to: 1. the relationship between the attribute(s) being measured or observed and the desired outcome; 2. the relationship between the activity (e.g., livestock grazing) and the attribute(s) being measured or observed; and 3. funds and workforce available to conduct the measurements or observations.

Assessments and Monitoring

The standards are the basis for assessing and monitoring rangeland condition and trend. Carrying out well-designed assessment and monitoring is critical to restoring or maintaining healthy rangelands and determining trends and conditions.

Assessments are a cursory form of evaluation based on the standards that can be used at different landscape scales. Assessments, conducted by qualified interdisciplinary teams (which may include but are not limited to physical, biological and social specialists, and interagency personnel) with participation from permittees and other interested parties, are appropriate at the watershed and sub watershed levels, at the allotment and pasture levels and on individual ecological sites or groups of sites. Assessments identify the condition or degree of function within the rangeland ecosystem and indicate resource problems and issues that should be monitored or studied in more detail. The results of assessments are a valuable tool for managers in assigning priorities within an administrative area and the subsequent allocation of personnel, money and time in resource monitoring and treatment. The results of assessments may also be used in making management decisions where an obvious problem exists.

Monitoring, which is the well documented and orderly collection, analysis and interpretation of resource data, serves as the basis for determining trends in the condition or degree of function of rangeland resources and for making management decisions. Monitoring should be designed and carried out to identify trends in resource conditions, to point out resource problems, to help indicate the cause of such problems, to point out solutions, and/or to contribute to adaptive management decisions. In cases where monitoring data do not exist, professional judgement, supported by interdisciplinary team recommendation, may be relied upon by the authorized officer in order to take necessary action. Review and evaluation of new information must be an ongoing activity.

To be effective, monitoring must be consistent over time, throughout administrative areas, and in the methods of measurement and observation of selected indicators. Those doing the monitoring must have the knowledge and skill required by the level or intensity of the monitoring being done, as well as the experience to properly interpret the results. Technical support for training must be made available.

Measurability

It is recognized that not every area will immediately meet the standards and that it will sometimes be a long-term process to restore some rangelands to. properly functioning condition. It is intended that in cases where standards are not being met, measurable progress should be made toward achieving those standards, and significant progress should be made toward fulfilling the fundamentals of rangeland health. Measurability is defined on a case-specific basis based upon the stated planning objectives (i.e., quantifiable, time specific), taking into account economic and social goals along with the biological and ecological capability of the area. To the extent that a rate of recovery conforms with the planning objectives, the area is allowed the time to meet the standard under the selected management regime.

Implementation

The material contained in this document will be incorporated into existing Land Use Plans and used in the development of new Land Use Plans. According to 43 CFR 4130.3-1, permits and leases shall incorporate terms and conditions that ensure conformance with 43 CFR 4180. Terms and conditions of existing permits and leases will be modified to reflect standards and guidelines at the earliest possible date with priority for modification being at the discretion of the authorized officer. Terms and conditions of new permits and leases will reflect standards and guidelines in their development.

Indicators identified in this document will serve as a focus of interpretation of existing monitoring data and will provide the basis of design for monitoring and assessment techniques, and in the development of monitoring and assessment plans.

The authorized officer shall take appropriate action as soon as practicable but not later than the start of the next grazing year upon determining, through assessment or monitoring by experienced professionals and interdisciplinary teams, that a standard is not being achieved and that livestock are a significant contributing factor to the failure to achieve the standards and conform with the guidelines.

Standards for Rangeland Health

Standard 1 Watershed Function - Uplands

Upland soils exhibit infiltration and permeability rates, moisture storage and stability that are appropriate to soil, climate and landform.

Rationale and Intent

This standard focuses on the basic physical functions of upland soils that support plant growth, the maintenance or development of plant populations and communities, and promote dependable flows of quality water from the watershed.

To achieve and sustain rangeland health, watersheds must function properly. Watersheds consist of three principle components: the uplands, riparian/wetland areas and the aquatic zone. This standard addresses the upland component of the watershed. When functioning properly, within its potential, a watershed captures, stores and safely releases the moisture associated with normal precipitation events (equal to or less than the 25 year, 5 hour event) that falls within its boundaries. Uplands make up the largest part of the watershed and are where most of the moisture received during precipitation events is captured and stored.

While all watersheds consist of similar components and processes, each is unique in its individual makeup. Each watershed displays its own pattern of landform and soil, its unique climate and weather patterns, and its own history of use and current condition. In directing management toward achieving this standard, it is essential to treat each unit of the landscape (soil, ecological site, and watershed) according to its own capability and how it fits with both smaller and larger units of the landscape.

A set of potential indicators has been identified for which site-specific criteria will be used to determine if this standard is being met. The appropriate indicators to be used in determining attainment of the standard should be drawn from the following list.

Potential Indicators

Protection of the soil surface from raindrop impact; detention of overland flow; maintenance of infiltration and permeability, and protection of the soil surface from erosion, consistent with the potential/capability of the site, as evidenced by the:

- amount and distribution of plant cover (including forest canopy cover);
- amount and distribution of plant litter;
- accumulation/incorporation of organic matter;
- amount and distribution of bare ground;
- amount and distribution of rock, stone, and gravel;
- plant composition and community structure;
- thickness and continuity of a horizon;
- character of microrelief;
- presence and integrity of biotic crusts;
- root occupancy of the soil profile;
- biological activity (plant, animal, and insect); and
- absence of accelerated erosion and overland flow.

Soil and plant conditions promote moisture storage as evidenced by:

- amount and distribution of plant cover (including forest canopy cover);
- amount and distribution of plant lifter;
- plant composition and community structure; and
- accumulation/incorporation of organic matter.

Standard 2 Watershed Function - Riparian/Wetland Areas

Riparian-wetland areas are in properly functioning physical condition appropriate to soil, climate, and landform.

Rationale and Intent

Riparian-wetland areas are grouped into two major categories: 1. lentic, or standing water systems such as lakes, ponds, seeps, bogs, and meadows; and 2. lotic, or moving water systems such as rivers, streams, and springs. Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and which under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Riparian areas commonly occupy the transition zone between the uplands and surface water bodies (the aquatic zone) or permanently saturated wetlands.

Properly functioning condition of riparian and wetland areas describes the degree of physical function of -these components of the watershed. Their functionality is important to water quality in the capture and retention of sediment and debris, the detention and detoxification of pollutants, and in moderating seasonal extremes of water temperature. Properly functioning riparian areas and wetlands enhance the timing and duration of streamflow through dissipation of flood energy, improved bank storage, and ground water recharge. Properly functioning condition should not be confused with the Desired Plant Community (DPC) or the Desired Future Condition (DFC) since, in most cases, it is the precursor to these levels of resource condition and is required for their attainment.

A set of indicators has been identified for which site-specific criteria will be used to determine if this standard is being met. The criteria are based upon the potential (or upon the capability where potential cannot be achieved) of individual sites or land forms.

Potential Indicators

Hydrologic, vegetative, and erosional/depositional processes interact in supporting physical function, consistent with the potential or capability of the site, as evidenced by:

- frequency of flood plain/wetland inundation;
- plant composition, age class distribution, and community structure;
- root mass;
- point bars re-vegetating;
- streambank/shoreline stability;
- riparian area width;
- sediment deposition;
- active/stable beaver dams;
- coarse/large woody debris;
- upland watershed conditions;
- frequency/duration of soil saturation; and
- water table fluctuation.

Stream channel characteristics are appropriate for landscape position as evidenced by:

- channel width/depth ratio;
- channel sinuosity;
- gradient;
- rocks and coarse and/or large woody debris;
- overhanging banks;
- pool/riffle ratio;
- pool size and frequency; and
- stream embeddedness.

Standard 3 Ecological Processes

Healthy, productive and diverse plant and animal populations and communities appropriate to soil, climate and landform are supported by ecological processes of nutrient cycling, energy flow and the hydrologic cycle.

Rationale and Intent

This standard addresses the ecological processes of energy flow and nutrient cycling as influenced by existing and desired plant and animal communities without establishing the kinds, amounts or proportions of plant and animal community compositions. While emphasis may be on native species, an ecological site may be capable of supporting a number of different native and introduced plant and animal populations and communities while meeting this standard. This standard also addresses the hydrologic cycle which is essential for plant growth and appropriatelevels of energy flow and nutrient cycling. Standards 1 and 2 address the watershed aspects of the hydrologic cycle.

With few exceptions, all life on earth is supported by the energy supplied by the sun and captured by plants in the process of photosynthesis. This energy enters the food chain when plants are consumed by insects and herbivores and passes upward through the food chain to the carnivores. Eventually, the energy reaches the decomposers and is released as the thermal output of decomposition or through oxidation.

The ability of plants to capture sunlight energy, to grow and develop, to play a role in soil development and watershed function, to provide habitat for wildlife and to support

economic uses depends on the availability of nutrients and moisture. Nutrients necessary for plant growth are made available to plants through the decomposition and metabolization of organic matter by insects, bacteria and fungi, the weathering of rocks and extraction from the atmosphere. Nutrients are transported through the soil by plant uptake, leaching and by rodent, insect and microbial activity. They follow cyclical patterns as they are used and reused by living organisms.

The ability of rangelands to supply resources and satisfy social and economic needs depends on the buildup and cycling of nutrients over time. Interrupting or slowing nutrient cycling can lead to site degradation, as these lands become increasingly deficient in the nutrients plants require.

Some plant communities, because of past use, frequent fire or other histories of extreme or continued disturbance, are incapable of meeting this standard. For example, shallow-rooted winter annual grasses that completely dominate some sites do not fully occupy the potential rooting depth of some soils, thereby reducing nutrient cycling well below optimum levels. In addition, these plants have a relatively short

growth period and thus capture less sunlight than more diverse plant communities. Plant communities like those cited in this example are considered to have crossed the threshold of recovery and often require great expense to be recovered. The cost of recovery must be weighed against the site's potential ecological/economic value in establishing treatment priorities.

The role of fire in natural ecosystems should be considered, whether it acts as a primary driver or only as one of many factors. It may play a significant role in both nutrient cycling and energy flows.

A set of indicators has been identified for which site-specific criteria will be used to determine if this standard is being met.

Potential Indicators

Photosynthesis is effectively occurring throughout the potential growing season, consistent with the potential/capability of the site, as evidenced by plant composition and community structure. Nutrient cycling is occurring effectively, consistent with the potential/capability of the site, as evidenced by:

- plant composition and community structure;
- accumulation, distribution, incorporation of plant litter and organic matter into the soil;
- animal community structure and composition;
- root occupancy in the soil profile; and
- biological activity including plant growth, herbivory, and rodent, insect and microbial activity.

Standard 4 Water Quality

Surface water and groundwater quality, influenced by agency actions, complies with State water quality standards.

Rationale and Intent

The quality of the water yielded by a watershed is determined by the physical and chemical properties of the geology and soils unique to the watershed, the prevailing

climate and weather patterns, current resource conditions, the uses to which the land is put and the quality of the management of those uses. Standards 1, 2 and 3 contribute to attaining this standard.

States are legally required to establish water quality standards and Federal land management agencies are to comply with those standards. In mixed ownership watersheds, agencies, like any other land owners, have limited influence on the quality of the water yielded by the watershed. The actions taken by the agency will contribute to meeting State water quality standards during the period that water crosses agency administered holdings.

Potential Indicators

Water quality meets applicable water quality standards as evidenced by:

- Water temperature;
- dissolved oxygen;
- fecal coliform;
- turbidity;
- pH;
- populations of aquatic organisms; and
- effects on beneficial uses (i.e., effects of management activities on beneficial uses as defined under the Clean Water Act and State implementing regulations).

Standard 5 Native, T&E, and Locally Important Species

Habitats support healthy, productive and diverse populations and communities of native plants and animals (including special status species and species of local importance) appropriate to soil, climate and landform.

Rationale and Intent

Federal agencies are mandated to protect threatened and endangered species and will take appropriate action to avoid the listing of any species. This standard focuses on retaining and restoring native plant and animal (including fish) species, populations and communities (including threatened, endangered and other special status species and species of local importance). In meeting the standard, native plant communities and animal habitats would be spatially distributed across the landscape with a density and frequency of species suitable to ensure reproductive capability and sustainability. Plant populations and communities would exhibit a range of age classes necessary to sustain recruitment and mortality fluctuations.

Potential Indicators

Essential habitat elements for species, populations and communities are present and available, consistent with the potential/capability of the landscape, as evidenced by:

- plant community composition, age class distribution, productivity;
- animal community composition, productivity;
- habitat elements;
- spatial distribution of habitat;
- habitat connectivity; and
- population stability/resilience.

Guidelines for Livestock Grazing Management

Guidelines for livestock grazing management offer guidance in achieving plan goals, meeting standards for rangeland health and fulfilling the fundamentals of rangeland health. Guidelines are applied in accordance with the capabilities of the resource in consultation, cooperation, and coordination with permitees/lessees and the interested public. Guidelines enable managers to adjust grazing management on public lands to meet current and anticipated climatic and biological conditions.

General Guidelines

1. Involve diverse interests in rangeland assessment, planning and monitoring.

2. Assessment and monitoring are essential to the management of rangelands, especially in areas where resource problems exist or issues arise. Monitoring should proceed using a qualitative method of assessment to identify critical, site specific problems or issues using interdisciplinary teams of specialists, managers, and knowledgeable land users.

Once identified, critical, site-specific problems o r issues should be targeted for more intensive, quantitative monitoring or investigation. Priority for monitoring and treatment should be given to those areas that are ecologically at-risk where benefits can be. maximized given existing budgets and other resources.

Livestock Grazing Management

1. The season, timing, frequency, duration and intensity of livestock grazing use shouldbe based on the physical and biological characteristics of the site- and the management unit in order to:

a. provide adequate cover (live plants, plant lifter and residue) to promote infiltration, conserve soil moisture and to maintain soil stability in upland areas;

b. provide adequate cover and plant community structure to promote streambank stability, debris and sediment capture, and floodwater energy dissipation in riparian areas.

c. promote soil surface conditions that support infiltration;

d. avoid sub-surface soil compaction that retards the movement of water in the soil profile;

e. help prevent the increase and spread of noxious weeds;

f. maintain or restore diverse plant populations and communities that fully occupy the potential rooting volume of the soil;

g. maintain or restore plant communities to promote photosynthesis throughout the potential growing season;

h. promote soil and site conditions that provide the opportunity for the establishment of desirable plants;

i. protect or restore water quality; and provide for the life cycle requirements, and maintain or restore the habitat elements of native (including T&E, special status, and locally important species) and desired plants and animals.

2. Grazing management plans should be tailored to site-specific conditions and plan objectives. Livestock grazing should be coordinated with the timing of precipitation, plant growth and plant form. Soil moisture, plant growth stage and the timing of peak stream flows are key factors in determining when to graze. Response to different grazing strategies varies with differing ecological sites.

3. Grazing management systems should consider nutritional and herd health requirements of the livestock.

4. Integrate grazing management systems into the year-round management strategy and resources of the permittee(s) or lessee(s). Consider the use of collaborative approaches (e.g., Coordinated Resource Management, Working Groups) in this integration.

5. Consider competition for forage and browse among livestock, big game animals, and wild horses in designing and implementing a grazing plan.

6. Provide periodic rest from grazing for rangeland vegetation during critical growth periods to promote plant vigor, reproduction and productivity.

7. Range improvement practices should be prioritized to promote rehabilitation and resolve grazing concerns on transitory grazing land.

8. Consider the potential for conflict between grazing use on public land and adjoining land uses in the design and implementation of a grazing management plan.

Facilitating the Management of Livestock Grazing

1. The use of practices to facilitate the implementation of grazing systems should consider the kind and class of animals managed, indigenous wildlife, wild horses, the terrain and the availability of water. Practices such as fencing, herding, water development, and the placement of salt and supplements (where authorized) are used where appropriate to:

   a. promote livestock distribution;

   b. encourage a uniform level of proper grazing use throughout the grazing unit;

   c. avoid unwanted or damaging concentrations of livestock on streambanks, in riparianareas and other sensitive areas such as highly erodible soils, unique wildlife habitats and plant communities; and

   d. protect water quality.

2. Roads and trails used to facilitate livestock grazing are constructed and maintained in a manner that minimizes the effects on landscape hydrology; concentration of overland flow, erosion and sediment transport are prevented; and subsurface flows are retained.

Accelerating Rangeland Recovery

1. Upland treatments that alter the vegetative composition of a site, like prescribed burning, juniper management and seeding or planting must be based on the potential of the site and should:

a. retain or promote infiltration, permeability, and soil moisture storage;

b. contribute to nutrient cycling and energy flow;

c. protect water quality;

d. help prevent the increase and spread of noxious weeds;

e. contribute to the diversity of plant communities, and plant community composition and structure;

f. support the conservation of T&E, other special status species and species of local importance; and

g. be followed up with grazing management and other treatments that extend the life of the treatment and address the cause of the original treatment need.

2. Seeding and planting of non-native vegetation should only be used in those cases. where native species are not available in sufficient quantities; where native species are incapable of maintaining or achieving the standards; or where non-native species are essential to the functional integrity of the site.

3. Structural and vegetative treatments and animal introductions in riparian and wetland areas must be compatible with the capability of the site, including the system's hydrologic regime, and contribute to the maintenance or restoration of properly functioning condition.

Appendix AA - Best Management Practices for the CSNM

Table of Contents

I. Introduction

A. Purpose

Best management practices (BMPs) are required by the Federal Clean Water Act (as amended by the Water Quality Act of 1987) to reduce nonpoint source pollution to the maximum extent practicable. BMPs are considered the primary mechanisms to achieve Oregon water quality standards.

Best management practices are defined as methods, measures, or practices selected on the basis of site-specific conditions to ensure that water quality will be maintained at its highest practicable level. BMPs include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (40 CFR 130.2, EPA Water Quality Standards Regulation).

Nonpoint sources of pollution result from natural causes, human actions, and the interactions between natural events and conditions associated with human use of the land and its resources. Nonpoint source pollution is caused by diffuse sources rather than from a discharge at a specific single location. Such pollution results in alteration of the chemical, physical, and biological integrity of water. Erosion from a harvest unit or surface erosion from a road are some examples of nonpoint sources.

The BMPs in this document are a compilation of existing policies and guidelines and commonly employed practices designed to maintain or improve water quality. Objectives identified in this BMP Appendix also include maintenance or improvement of soil productivity and fish habitat since they are closely tied to water quality. Selection of appropriate BMPs will help meet Monument Aquatic Conservation Strategy objectives (Appendix BB) during management action implementation. Practices included in this Appendix supplement the Management Actions/Directions for Riparian Reserves (Appendix BB) and they should be used together.

B. Organization and Use

This document is organized by management activities plus separate sections that address activity planning and design, riparian reserves, wetlands, and fragile soils. Objectives are stated under each management activity followed by a list of practices designed to achieve the objectives.

BMPs are selected and implemented as necessary based on site-specific conditions to meet water quality, soil, or fish objectives for specific management actions. BMPs and Riparian Reserve Management Actions/Direction (Appendix BB) may be modified to meet site specific situations. This Appendix does not provide an exhaustive list of BMPs. Additional nonpoint source control measures may be identified during watershed analysis or during the interdisciplinary process when evaluating site-specific management actions. Implementation and effectiveness of BMPs need to be monitored to determine whether the practices are correctly designed and applied to achieve the objectives. BMPs will be adjusted as necessary to ensure objectives are met.

Review and update of this Appendix will be an ongoing process. Updates will be made as needed to conform with changes in Bureau of Land Management policy, direction, or new information.

II. Project Planning and Design

A. Planning

Objective: To include soil productivity, water quality, aquatic habitat, and hydrologic considerations in project planning.

Practices:

1. Use information from the Cascade-Siskiyou National Monument (CSNM) Resource Management Plan (RMP) and appropriate watershed analyses to prepare project level plans.

2. Use timber production capability classification (TPCC) inventory to identify areas classified as fragile due to slope gradient, mass movement potential, surface erosion potential, and high ground water levels.

3. Use the planning process to identify, evaluate, and map potential problems (e.g., slump-prone areas, saturated areas and slide areas) that were not addressed in the watershed analysis.

4. Analyze watershed cumulative impacts and provide mitigation measures if necessary to meet water quality requirements (see section II. D.).

5. Use the CSNM Resource Management Plan and appropriate watershed analysis information to determine potential for natural and activity-created high intensity wildfires at the project level. Reduce potential for high intensity wildfires through proposed management activities.

B. Design

Objective:To ensure that management activities maintain favorable conditions of soil productivity, water flow, water quality, and aquatic habitat.

Practices:

1. Design proposed management activities to mitigate potential adverse impacts to soil, water, and aquatic habitat. Evaluate factors such as soil characteristics, watershed physiography, current watershed and stream channel conditions, proposed roads, skid trails, logging system design, etc., to determine impacts of proposed management activities.

2. Design mitigation measures if adverse impacts to water quality/quantity, aquatic habitat, or soil productivity may result from the proposed action.

C. Maps/Contract Requirements

Objective: To identify riparian reserves to be protected and to ensure their protection on the ground.

Practices:Include the following on activity maps and/or contracts:

1. Locate all stream channels, lakes, ponds, reservoirs, and wetlands (springs, seeps, bogs, etc.) with appropriate riparian reserves on project map and/or contracts.

2.Include protection required for identified water bodies on project maps and/or contracts.

D. Cumulative Impacts

Objective: To minimize detrimental impacts on water and soil resources resulting from the cumulative impact of land management activities within a watershed.

Practices:

1. Coordinate scheduling of management activities such as timber sales, road construction, and watershed restoration activities with other landowners in the watershed.

2. Use information from the CSNM RMP, appropriate watershed analysis, and water quality management plans to identify areas with a high level of cumulative impacts.

a. Use the following general guidelines to delineate areas for cumulative impact analyses.
   1) Natural drainage boundaries.
   2) Third to fifth order drainages (approximately 500 to 10,000 acres).
   3) Lower boundary location based on a state-designated beneficial use.
b. The extent to which any or all of the following criteria exist would determine which drainage areas have a high risk for water quality degradation due to cumulative impacts. The criteria are not listed in order of priority.
   1) Highly erodible soils (i.e., subject to surface erosion, landslides, or slumps).
   2) Large percent of forest vegetation harvested.
   3) Large area of compacted soil.
   4) Large percent of nonrecovered openings in transient snow zone.
   5) High sedimentation potential.
   6) Poor to fair channel stability or condition.
   7) Poor to fair riparian condition (nonfunctional or functional-at risk with down ward trend).
   8) High impact from catastrophic event (e.g., wildfire).
   9) High road density.
   10) Potential for adverse impact on a beneficial use.
   11) Waterbody included on State water quality limited 303(d) list.
   12) Monitoring data shows that water quality does not meet state water quality standards.

3. For drainage areas identified as having a high risk for water quality degradation, an intensive evaluation should follow the initial analysis and include the nature of the problem, the cause of the problem, and a specific plan with objectives and alternatives for recovery and mitigation. Water monitoring may also be initiated to validate the conclusion of the impact analysis and to establish baseline data.

4. Based on site-specific conditions, select and apply special management practices such as the following to mitigate water quality impacts in high risk drainage areas.

a. Develop and implement a watershed/riparian restoration plan and encourage coordination with landowners.
b. Require management plans for rights-of-way construction and grazing.
c. Defer the drainage area for approximately five years from management activities that could potentially degrade water quality. Reanalyze the drainage area at the end of five years.
d. Increase widths of riparian reserves.
e. Utilize ecosystem-based concepts for vegetation management.

f. Require helicopter yarding for vegetation management treatments.
g. Require full suspension cable yarding for vegetation management treatments.
h. Require seasonal restrictions with no waivers for timber falling and yarding.
i. Minimize existing and prevent additional road caused impacts:
   1) reduce road density;
   2) minimize road width and clearing limits;
   3) require transport of excavated materials to appropriate disposal site (end hauling);
   4) prohibit new road construction;
   5) no unsurfaced roads;
   6) require seasonal restrictions with no waivers for construction, renovation, and hauling;
   7) require special low impact maintenance and construction techniques;
   8) no roadside brushing/grubbing with excavator;
   9) no blading and ditch pulling in the winter unless essential to provide drainage;
   10) rock ditch lines;
   11) pull back sidecast from road construction and recontour roadway; and
   12) remove culverts and reshape drainageway crossings.
j. Enforce closure for off-highway vehicle use.
k. Implement regular compliance reviews on all activities in the drainage area.
l. Assess trade-offs between wildfire suppression impacts and wildfire damage; plan suppression levels accordingly. Limit use of heavy equipment during wildfire suppression.

III. Riparian Reserves

Objective: To meet the Monument Aquatic Conservation Strategy objectives in Appendix BB.

Practices:

1. Comply with riparian reserve widths described in Appendix BB.

2. Follow the Management Actions/Direction for riparian reserves in Appendix BB.

IV. Wetlands

Objective: To meet the Monument Aquatic Conservation Strategy objectives in Appendix BB.

Practices:

1. Comply with riparian reserve widths described in Appendix BB.

2. Follow the Management Action/Direction for riparian reserves in Appendix BB.

V. Fragile Soils

The BMPs in this section are to be used in addition to those in other sections.

Four categories of fragile soils sensitive to surface-disturbing activities are identified in Medford District's timber production capability classification (TPCC) and shown on map 9 of CSNM DRMP (USDI 2001):

Fragile Slope Gradient (FG)
These sites consist of steep to extremely steep slopes that have a high potential for surface ravel. Gradients commonly range from 60 to greater than 100 percent.

Fragile Mass Movement (FP)
These sites consist of deep seated, slump, or earth flow types of landslides with undulating topography and slope gradients generally less than 60 percent. Soils are derived from volcanic tuffs or breccias.

Fragile Surface Erosion (FM)
These sites have soil surface horizons that are highly erodible. Soils are derived from granite or schist bedrock.

Fragile Groundwater (FW)
These sites have high water tables where water is at or near the soil surface for sufficient periods of time that vegetation survival and growth are affected.

Objective: To minimize surface disturbance on fragile soils.

A. Roads - Fragile Soils

1. Planning

Practice: Avoid fragile soils when planning road systems unless approved by an interdisciplinary team that includes a soil scientist and hydrologist.

2. Design

Practices:

a. Design haul roads with rock surface on FM, FP, and FW soils.

b. Use slotted risers, trash racks, or over-sized culverts to prevent culvert plugging on FM and FP soils.

3. Erosion Control

Practices:

1. Stabilize cutbanks, fillslopes, and ditchlines on FM soils using methods such as vegetation (grass seeding, deep rooted plants, etc.), terracing, rock buttressing, and rock armoring ditchlines.

2. Stabilize cutbanks on FP soils using rock buttressing.

3. Decommission or obliterate temporary spur roads as appropriate for site-specific condition using methods such as scarifying the road bed, planting tree seedlings or grass, restoring the natural ground contour, and water barring.

4. Maintenance

Practice: Minimize ditch cleaning on FM and FP soils to retard slumping of road and cutbanks.

5. Access Restrictions

Practice:Block unsurfaced roads on fragile soils to prohibit motorized vehicle use.

B. Timber Management Activities - Fragile Soils

1. Yarding Methods - Cable

Practices:

a. Use full or partial suspension when yarding on FG, FM, and FW soils.

b. Construct hand waterbars in cable yarding corridors on FM soils where gouging occurs immediately after use according to guidelines in section VIII.B.1.

c. Restrict yarding and hauling to dry season (generally May 15 to October 15) on FM, FP, and FW soils.

2. Yarding Methods - Tractor

Practice: Avoid tractor yarding unless approved by an interdisciplinary team that includes soil scientist and hydrologist.

3. Yarding Methods - Helicopter

Practice: Employ helicopter yarding to avoid or minimize new road construction on fragile soils.

C. Silviculture - Fragile Soils

1. Prescribed Fire - Underburn

Practice: Prescribe cool burns and only burn in the spring on FG and FM soils.

2. Prescribed Fire - Piling

a. Hand - Practices

1. Put slash in yarding corridors on FG and FM soils to control erosion, allowing adequate space to plant trees.

2. Burn handpiles on FG and FM soils only if they prevent planter access.

b. Machine - Practices

1. Avoid machine piling or ripping on FM, FP, and FW soils unless approved by an interdisciplinary team that includes a soil scientist and hydrologist.

D. Wildfire - Fragile Soils

1. Suppression - Practices

   a. Apply suppression on fragile soils based on environmental and operational conditions that exist at time of ignition.

   b. Limit the use of tractors and other major surface-disturbing activities on all fragile soils.

2.Rehabilitation - Practice

   a. Assure prompt rehabilitation on fragile soils through seeding or planting of native species.

E. Rights-of-Way - Fragile Soils

Practices:

1. Avoid facility construction on FM and FP soils unless approved by an interdisciplinary team that includes a soil scientist and hydrologist.

2. Design rights-of-ways to minimize surface disturbance on FM and FP soils.

VI. Roads and Landings

A. Planning

Objective: To plan road systems that meet resource objectives and minimize detrimental impacts on water and soil resources and aquatic habitat.

Practices:

1. Follow the transportation management plan in Appendix CC.

2. Implement transportation management objectives that minimize adverse environmental impacts.

3. Use an interdisciplinary team to perform a project level, site-specific analysis for any proposed road construction.

4. Avoid fragile and unstable areas unless approved by an interdisciplinary team that includes an engineer, soil scientist, and hydrologist.

5. Avoid new road construction or landings within riparian reserves and wetlands unless approved by an interdisciplinary team that includes an engineer, fisheries biologist, hydrologist, and soil scientist.

6. Obtain necessary fill/removal permits from Division of State Lands and/or U.S. Corp of Engineers.

7. Plan in-stream work to coincide with the Oregon Department of Fish and Wildlife (ODFW) work period:
   Bear Creek WatershedJune 15 - September 15
   Jenny Creek WatershedJuly 1 - January 31
   Klamath River-Iron Gate WatershedJuly 1 - March 31
   Cottonwood Creek WatershedJune 15 - September 15

8. Encourage use of BMPs where not specifically required in reciprocal right-of-way agreements.

B. Location

Objective: To minimize soil erosion, water quality degradation, and disturbance of riparian vegetation or aquatic habitat.

Practices:

1. Locate roads on stable positions (e.g., ridges, natural benches, and flatter transitional slopes near ridges and valley bottoms). Implement extra mitigation measures when crossing unstable areas is necessary.

2. Avoid headwalls, midslope locations on steep unstable slopes, seeps, old landslides, slopes in excess of 70 percent, and areas where the geologic bedding planes or weathering surfaces are inclined with the slope.

3. Locate roads to minimize heights of cutbanks. Avoid high, steeply sloping cutbanks in highly fractured bedrock.

4. Locate roads on well-drained soil types. Roll the grade to avoid wet areas.

5. Locate stream crossing sites where channels are well defined, unobstructed and straight.

C. Design

1. General

Objective: To design the lowest standard of road consistent with use objectives and resource protection needs.

Practices:

1. Base road design standards and design criteria on road management objectives such as traffic requirements of the proposed activity and the overall transportation plan, an economic analysis, safety requirements, resource objectives, and the minimization of damage to the environment.

2. Consider future maintenance concerns and needs when designing roads.

3. Preferred road gradients are 2 to 10 percent with a maximum grade of 15 percent. Consider steeper grades only in those situations where they will result in less environmental impact. Avoid grades less than 2 percent.

4. Road Surface Configurations

   a. Outsloping - sloping the road prism to the outside edge for surface drainage is normally recommended for local spurs or minor collector roads where low volume traffic

and lower traffic speeds are anticipated. It is also recommended in situations where long intervals between maintenance will occur and where minimum excavation is desired. Outsloping is not recommended on gradients greater than 8 to 10 percent.

b. Insloping - sloping the road prism to the inside edge is an acceptable practice on roads with gradients more than 10 percent and where the underlying soil formation is very rocky and not subject to appreciable erosion or failure.

c. Crown and Ditch - this configuration is recommended for arterial and collector roads where traffic volume, speed, intensity and user comfort are a consideration. Gradients may range from 2 to 15 percent as long as adequate drainage away from the road surface and ditchlines is maintained.

5. Minimize excavation through the following actions: use of balanced earthwork, narrow road width, and endhauling where slopes are greater than 60 percent.

6. Locate waste areas suitable for depositing excess excavated material.

7. Consider slope rounding on tops of cut slopes in clayey soils to reduce sloughing and surface ravel. Avoid this practice in erosion classes I, II, VII and VIII (see Table AA-1).

8. Surface roads if they will be subject to traffic during wet weather. The depth and gradation of surfacing will be determined by traffic type, frequency, weight, maintenance objectives, and the stability and strength of the road foundation and surface materials.

9. Provide vegetative or artificial stabilization of cut and fill slopes in the design process. Avoid establishment of vegetation where it inhibits drainage from the road surface or where it restricts safety or maintenance.

10. Prior to completion of design drawings, field check the design to assure that it fits the terrain, drainage needs have been satisfied, and all critical slope conditions have been identified and adequate design solutions applied.

2. Surface Cross Drain Design

Objective: To design road drainage systems that minimize concentrated water volume and velocity and therefore to reduce soil movement and maintain water quality.

Practices:

1. Design cross drains in ephemeral or intermittent channels to lay on solid ground rather than on fill material to avoid road failures.

2. Design placement of all surface cross drains to avoid discharge onto erodible (unprotected) slopes or directly into stream channels. Provide a buffer or sediment basin between the cross drain outlet and the stream channel.

3. Locate culverts or drainage dips in such a manner to avoid discharge onto unstable terrain such as headwalls, slumps, or block failure zones. Provide adequate spacing to avoid accumulation of water in ditches or surfaces through these areas.

4. Provide energy dissipators (e.g., rock material) at cross drain outlets or drain dips where water is discharged onto loose material or erodible soil or steep slopes.

5. Place protective rock at culvert entrance to streamline water flow and reduce erosion.

6. Use the guide for drainage spacing by soil erosion classes and road grade shown in Tables AA-1 and AA-2.

7. Use drainage dips in place of culverts on roads that have gradients less than 10 percent or where transportation management objectives result in blocking roads. Avoid drainage dips on road gradients greater than 10 percent.

8. Locate drainage dips where water might accumulate or where there is an outside berm that prevents drainage from the roadway.

9. When sediment is a problem, design cross drainage culverts or drainage dips immediately upgrade of stream crossings to prevent ditch sediment from entering the stream.

10. Rolling the gradient is recommended in erodible and unstable soils to reduce surface water volume and velocities and culvert requirements.

3. Stream Crossing Design

Objective: To prevent stream crossings from being a direct source of sediment to streams thus minimizing water quality degradation; to provide unobstructed access to spawning and rearing areas for anadromous and resident fish.

Practices:

1. Design stream crossing structures to ensure passage of juvenile and adult fish and other aquatic species.

2. Design stream crossing approach to be as near a right angle to the stream as possible to minimize streambank and riparian habitat disturbances.

3. Minimize the number of crossings on any particular stream.

4. Where feasible, design culvert placement on a straight reach of stream to minimize erosion at both ends of the culvert. Design adequate stream bank protection (e.g., rip-rap) where scouring would occur. Avoid locations that require a stream channel to be straightened beyond the length of a culvert to facilitate installation of a road crossing.

5. Design stream crossings for fish-bearing streams to maintain natural streambed substrate and site gradient where feasible.

6. Design stream crossing structure width to be at least as wide as the bankfull width of the crossing site.

7. Consider lining the bottom of the crossing structure with boulders sized to withstand a 100- year flood event to restore streambed habitat complexity.

8. Consider designing a control weir or rock apron for a culvert outlet if needed to prevent downcutting below the culvert.

9. Evaluate on a case-by-case basis the need to maintain aquatic connectivity on nonfish-bearing streams to ensure upstream movement of other aquatic species.

4. Temporary Stream Crossing Design

Objective: To design temporary stream crossings that minimize disturbance of the stream and riparian environment.

Practices:

1. Evaluate the advantages and disadvantages of a temporary versus permanent crossing structure for access to the area during all seasons over the long term in terms of economics, maintenance, and resource requirements.

2. Design temporary structures such as prefabricated temporary timber bridges, multiple culverts with minimum fill height, cattleguard crossings, or log cribs to keep vehicles out of the stream.

3. Consider using 1 to 3 inch diameter washed, uncrushed river rock as culvert fill material to provide good spawning substrate after the culvert is removed. Place geotextile fabric over the rock.

4. Minimize the number of temporary crossings on a particular stream.

5. Avoid temporary stream crossings on fishery streams unless approved by an interdisciplinary team that includes a fisheries biologist.

5. Low Water Ford Stream Crossing Design

Objective: To design low water fords that minimize disturbance of the stream and riparian environment.

Practice: Use only when site conditions make it impractical or uneconomical to utilize a permanent or temporary crossing structure.

D. Construction

Objective: To create a stable roadway while minimizing soil erosion and potential degradation of water quality or aquatic habitat.

1. Roadway Construction

Practices:

1. Limit road construction to the dry season (generally between May 15 and October 15). When conditions permit operations outside of the dry season, keep erosion control measures current with ground disturbance to the extent that the affected area can be rapidly closed/blocked and weatherized if weather conditions warrant.

2. Manage road construction so that any construction can be completed and bare soil can be protected and stabilized prior to fall rains.

3. Confine preliminary equipment access (pioneer road) to within the roadway construction limits.

4. Construct pioneer road so as to prevent undercutting of the designated final cutslope and prevent avoidable deposition of materials outside the designated roadway limits. Conduct slope rounding, if required, at the first opportunity during construction to avoid

excess amounts of soil being moved after excavation and embankment operations are completed.

5. Use controlled blasting techniques that minimize amount of material displaced from road location.

6. Locate waste stockpile and borrow sites outside of riparian reserves.

7. Construct embankments, including waste disposal sites, of appropriate materials (no slash or other organic matter) using one or more of the following methods:

a. layer placement (tractor compaction),
b. layer placement (roller compaction), and
c. controlled compaction (85 to 95 percent maximum density).

Slash and organic material may remain under waste embankment areas outside the road prism and outside units planned for broadcast burning.

8. Avoid sidecasting where it will adversely effect water quality or weaken stabilized slopes.

9. Provide surface drainage prior to fall rains.

10. Clear drainage ditches and natural watercourses of woody material deposited by construction or logging above culverts prior to fall rains.

2. Stream Crossing Construction

Practices:

1. Confine culvert installation to the low flow period in accordance with Oregon Department of Fish and Wildlife guidelines for timing of in-stream work (VI.A.7.) to minimize sedimentation and the adverse effects of sediment on aquatic life.

2. Divert the stream around the work area to minimize downstream sedimentation. Require the contractor to submit an approved plan for water diversion before in-stream work begins. Maintain diversion until all in-stream work has been completed.

3. Use material such as straw bales, geotextile fabric, or coconut fiber logs/bales immediately downstream from the work area to reduce sediment movement downstream.

4. Prevent wet or green cement and new or old asphalt from entering a stream.

5. Place culverts in the streambed at the existing slope gradient on larger nonfish-bearing streams. Place energy dissipators (e.g., large rock) at the outfall of culverts on small nonfish-bearing streams to reduce water velocity and minimize scour at the outlet end.

6. Countersink culvert at least 6 to 8 inches below the streambed to minimize scouring at the outlet. Increase culvert diameters accordingly.

7. Limit activities of mechanized equipment in the stream channel to the area necessary for installation.

8. Notify contractors that they are responsible for meeting all state and federal requirements for maintaining water quality including the following:

a. Inspect and clean heavy equipment as necessary before moving onto the project site in order to remove oil and grease, noxious weeds and excessive soil.
b. Ensure that hydraulic fluid and fuel lines on heavy mechanized equipment are in proper working condition in order to prevent leakage into streams.
c. Remove from the site and dispose any waste diesel, oil, hydraulic fluid and other hazardous materials and contaminated soil near the stream in accordance with DEQ regulations. Excavate areas that have been saturated with toxic materials to a depth of 12 inches beyond the contaminated material or as required by DEQ.
d. Conduct equipment refueling within a confined, secured area outside the stream channel such that there is minimal chance that toxic materials could enter a stream.
e. Use spill containment booms or as required by DEQ.
f. Bar storage of equipment containing toxic fluids in a stream channel anytime.

9. Place permanent stream crossing structures in fishery streams before heavy equipment moves beyond the crossing area. Where this is not feasible, install temporary crossings to minimize stream disturbance.

10. Place rip-rap on fills around culvert inlets and outlets.

11. Stabilize fill material over a stream crossing structure as soon as possible after construction is completed.

12. Cover bare soil areas with appropriate material (e.g. hydro-seeding, native seed, weed-free straw, bark chips, etc.) prior to fall rain or when moisture conditions are adequate.

3. Temporary Stream Crossing Construction

Practices:

1. Where possible, limit the installation and removal of temporary crossing structures to only one time during the same year and within the prescribed work period. Installation and removal should occur in accordance with Oregon Department of Fish and Wildlife guidelines for timing of in-stream work (VI.A.7.).

2. Use backfill material that is as soil-free as practicable over temporary culverts. Whenever possible use washed river rock covered by pit run or one inch minus as a compacted running surface.

3. Spread and reshape clean fill material to the original lines of the streambed after a crossing is removed to ensure the stream remains in its channel during high flow.

4. Use log cribbing in tractor logging units when it is impractical to use a culvert and rock backfill material. Remove upon completion of logging the unit.

5. Limit activities of mechanized equipment in the stream channel to the area that is necessary for installation and removal operations.

6. Remove stream crossing drainage structures and in-channel fill material during low flow and prior to fall rains. Reestablish natural drainage configuration, including the bankfull width.

4. Low Water Ford Stream Crossing Construction

Practices:

1. Restrict construction and use to low flow period in accordance with Oregon Department of Fish and Wildlife guidelines for timing of in-stream work.

2. Use washed rock/gravel or concrete slab in the crossing.

3. Apply rock on road approaches (normally within 150 feet of each side of the ford) to prevent washing and softening of the road surface.

E. Landings

Objective: To minimize soil disturbance, soil erosion, soil productivity losses, and water quality degradation.

Practices:

1. Locate landings at sites approved by an interdisciplinary team that includes a soil scientist, hydrologist, and fisheries biologist.

2. Avoid placing landings adjacent to or in meadows or wetland areas.

3. Clear or excavate landings to minimum size needed for safe and efficient opertions.

4. Select landing locations considering the least amount of excavation, erosion potential, and where sidecast will not enter drainages or damage other sensitive areas.

5. Deposit excess excavated material on stable sites where there is no erosion potential. Construct waste disposal sites according to guidelines in VI.D.1.7.

6. Restore landings to the natural configuration or shape to direct the runoff to preselected spots where water can be dispersed to natural, well-vegetated, gentle ground.

F. Road Erosion Control

Objective: To limit and mitigate soil erosion and sedimentation.

Practices:

1. Apply protective measures to all areas of disturbed, erosion-prone, unprotected ground, including waste disposal sites, prior to fall rains. Protective measures may include water bars, water dips, grass seeding, planting deep rooted vegetation, and/or mulching. Armor or buttress fill slopes and unstable areas with rock which meets construction specifications. See section VII.B.1. for water bar (water dip) spacing and construction guidelines.

2. Surface roads that are to be left open to traffic from October 15 through May 15.

3. Close roads that are not adequately surfaced from October 15 through May 15.

G. Road Renovation/Improvement

Objective: To restore or improve a road to a desired standard in a manner that minimizes sediment production and water quality degradation.

Practices:

1. Improve flat gradients to a minimum of two (2) percent or provide raised subgrade sections (turnpike) to avoid saturation of the road prism.

2. Reconstruct culvert catchbasins to specifications. Catchbasins in solid rock need not be reconstructed provided water flow is not restricted by soil, rock, or other debris.

3. Identify potential water problems caused by off-site disturbance and add necessary drainage facilities.

4. Identify ditchline and outlet erosion caused by excessive flows and add necessary drainage facilities and armoring.

5. Replace undersized culverts and repair damaged culverts and downspouts.

6. Add additional full-rounds, half-rounds, and energy dissipators as needed.

7. Correct special drainage problems (e.g., high water table, seeps) that effect stability of subgrade through the use of perforated drains, geotextiles, or drainage bays.

8. Eliminate undesirable berms that retard normal surface runoff.

9. Restore outslope or crown sections.

10. Avoid disturbing backslope while reconstructing ditches.

11. Surface inadequately surfaced roads that are to be left open to traffic during wet weather.

12. Require roadside brushing be done in a manner that prevents disturbance to root systems (i.e., avoid using excavators for brushing).

H. Road Maintenance

Objective: To maintain roads in a manner that protects water quality and minimizes erosion and sedimentation.

Practices:

1. Provide basic custodial care to protect the road investment and to ensure minimal damage to adjacent land and resources.

2. Perform blading and shaping to conserve existing surface material, retain the original crowned or outsloped self-draining cross section, prevent or remove rutting berms (except those designed for slope protection) and other irregularities that retard normal surface runoff. Avoid wasting loose ditch or surface material over the shoulder where it can cause stream sedimentation or weaken slump prone areas. Avoid undercutting backslopes.

3. Keep road inlet and outlet ditches, catchbasins, and culverts free of obstructions, particularly before and during winter rainfall. However, keep routine machine cleaning of ditches to a minimum during wet weather.

4. Promptly remove slide material when it is obstructing road surface and ditchline drainage. Save all soil or material useable for quarry reclamation and stockpile for future reclamation projects. Utilize remaining slide material for needed road improvement or place in a stable waste area (outside of riparian reserves). Avoid sidecasting of slide material where it can damage, overload, saturate embankments, or flow into downslope drainage courses. Reestablish vegetation in areas where more than 50 percent of vegetation has been destroyed due to sidecasting.

5. Retain vegetation on cut slopes unless it poses a safety hazard or restricts maintenance activities. Cut roadside vegetation rather than pulling it out and disturbing the soil.

6. Minimize disturbance of existing vegetation in ditches and at stream crossings to the greatest extent possible.

7. Minimize soil disturbance and displacement, but where sediment risks warrant, prevent off-site soil movement through the use of filter materials (such as weed-free straw bales or silt fencing) if vegetation strips are not available.

8. Replace stream crossing structures needing to be upgraded with structures designed to accommodate at least the 100-year flood, including associated bedload and debris.

9. Refuel power equipment (or use absorbent pads for immobile equipment) and prepare concrete at least 100 feet away from water bodies to prevent direct delivery of contaminants into a water body.

10. Remove snow on haul roads in a manner that will protect roads and adjacent resources. Remove or place snow berms to prevent water concentration on the roadway or on erodible sideslopes or soils.

11. Patrol areas subject to road or watershed damage during periods of high runoff.

I. Dust Abatement

Objective: To minimize movement of fine sediment from roads; to prevent introduction into waterways of chemicals applied for dust abatement.

Practices:

1. Use dust palliatives or surface stabilizers to reduce surfacing material loss and buildup of fine sediment that may wash off into water courses.

2. Closely control application of dust palliatives and surface stabilizers, equipment cleanup, and disposal of excess material to prevent contamination or damage to water resources.

3. Avoid application of dust abatement materials (such as lignon or mag-chloride) during or just before wet weather and at stream crossings or other locations that could result in direct delivery to a water body.

J. Road Access Restrictions

Objective: To reduce road surface damage and therefore minimize erosion and sedimentation.

Practices:

1. Barricade or block roads using gates, guard rails, earth/log barricades, boulders, logging debris, or a combination of these methods. Avoid blocking roads that will need future maintenance (i.e., culvert cleaning, slide removal, etc.) with unremovable barricades. Use guardrails, gates, or other barricades capable of being opened for roads needing future maintenance.

2. Provide maintenance of blocked roads in accordance with design criteria.

3. Install waterbars, cross drains, cross sloping, or drainage dips if not already on road to assure drainage.

4. Scarify, mulch, and/or seed for erosion control.

K. Road and Landing Decommissioning

Objective: To reduce soil compaction, minimize or reduce sedimentation, and improve site productivity by decommissioning roads and landings and rehabilitating the land.

Practices:

1. Use an interdisciplinary team to identify and prioritize roads, skid roads, and landings for decommissioning. Assign highest priorities to roads in unstable areas and riparian reserves.

2. Conduct activities during dry conditions. Maximize activities during late summer and early fall to best avoid wet conditions.

3. Rip roads and landings by an approved method to remove ruts, berms, and ditches while leaving or replacing surface cross drain structures.

4. Minimize disturbance of existing vegetation in ditches and at stream crossings to the extent necessary to restore the hydrologic function of the subject road.

5. Minimize soil disturbance and displacement, but where sediment risks warrant, prevent off-site soil movement through use of filter materials (such as weed-free straw bales or silt fencing) if vegetation strips are not available.

6. Revegetate decommissioned areas with native species.

L. Water Source Development

Objective: To supply water for various resource programs while protecting water quality and riparian vegetation.

Practices:

1. Design and construct durable, long-term water sources.

2. Avoid reduction of downstream flow which would detrimentally effect aquatic resources, fish passage, or other uses.

3. Direct overflow from water-holding developments back into the stream.

4. Locate road approaches to in-stream water source developments to minimize potential impacts in the riparian zone. Apply rock to surface of these approaches to reduce the effects of sediment washing into the stream.

5. Avoid use of road fills for water impoundment dams unless specifically designed for that purpose. Remove any blocking device prior to fall rains.

6. Construct water sources during the dry season in accordance with the Oregon Department of Fish and Wildlife guidelines for timing of in-stream work (VI.A.7.).

M. Rock Quarry Reclamation

Objective: To minimize sediment production from quarries and associated crusher pad developments susceptible to erosion due to steep sideslopes, lack of vegetation, or their proximity to water courses.

Practices:

1. Prior to excavation, remove topsoil and place at a site with minimal erosion potential. Stockpile topsoil for surface dressing during the post-operation rehabilitation.

2. Use culverts and rip-rap for crusher pad drainage when necessary.

3. Stabilize quarry cutbanks and general quarry area.

4. Revegetate with native species, apply mulch, and provide adequate drainage to minimize erosion.

5. Rip, waterbar, block, fertilize, and revegetate access roads to quarries where no future entry is planned.

VII. Timber Management Activities

A. Yarding Methods

1. Cable

Objective: To minimize soil damage and erosion caused by displacement or compaction.

Practices:

a. Use full or partial suspension when yarding on erodible or ravel prone areas where practical.

b. Use full or partial suspension with seasonal restrictions on areas of high water tables.

c. Use seasonal restriction if required suspension cannot be achieved by yarding equipment.

d. Avoid downhill yarding.

2. Tractor

Objective: To minimize loss of soil productivity and reduce potential for surface runoff and subsequent water quality degradation.

Practices:

a. In previously unentered stands, use designated skid roads to limit soil disturbance to less than 12 percent of the harvest area.

b. Minimize width of skid roads.

c. For stands previously logged with tractors, utilize existing skid roads. Rip all skid roads used in final entry harvest.

d. Rip skid roads discontinuously, preferably with winged ripper teeth when the soil is dry. Rips should be spaced no more than 36 inches apart and from 12 to 18 inches deep or to bedrock, whichever is shallower. Designated skid roads should be ripped if they will not be used again until the next rotation.

e. Avoid placement of skid roads through areas with high water tables.

d. Use appropriate seasonal restrictions that would result in no off-site damage for designated skid roads.

e. Allow logging on snow when snow depth is 18 inches or greater and negligible ground surface exposure occurs during the operation.

f. Restrict tractor operations to slopes less than 35 percent.

g. Construct waterbars on skid roads according to guidelines in section VII.B.1.

3. Helicopter

Objective: To minimize surface disturbance on high risk watersheds.

Practice: Employ helicopter yarding to avoid or minimize new road construction in high risk watersheds.

4. Horse

Objective: To minimize soil disturbance, soil compaction, and soil erosion.

Practices:

a. Limit horse logging to slopes less than 20 percent.

b. Construct hand waterbars on horse skid trails according to guidelines in section VII.B.1.

c. Limit harvest activity to times when soil moisture content at a six-inch depth is less than 25 percent by weight.

B. Erosion Control for Timber Management Activities

1. Waterbars

Objective: To minimize soil erosion.

Practices:

1. Construct adequate waterbars on skid roads, yarding corridors, and fire lines prior to fall rains.

2. Use the following table for waterbar spacing, based on gradient and erosion class.

Table AA-1. Water Bar Spacing by Gradient and Erosion Class

Gradient (%)	Water Bar Spacing[1] (feet) by Erosion Class[2]		
	High	Moderate	Low[3]
2-5	200	300	400
6-10	150	200	300
11-15	100	150	200
16-20	75	100	150
21-35	50	75	100
36+	50	50	50

1/Spacing is determined by slope distance and is the maximum allowed for the grade.
2/ The following guide lists rock types according to erosion class:
High: granite, sandstone, andesite porphyry, glacial or alluvial deposits, soft matrix conglomerate, volcanic ash, pyroclastics;
Moderate: basalt, andesite, quartzite, hard matrix, conglomerate, rhyolite;
Low: metasediments, metavolcanics, hard shale.

3. Use the following techniques to construct waterbars:

a. Open the downslope end of the waterbar to allow free passage of water.

b. Construct the waterbar so that it will not deposit water where it will cause erosion.

c. Compact the waterbar berm to prevent water from breaching the berm.

d. Skew waterbars no more than 30 degrees from perpendicular to the centerline of the trail or road.

2. Revegetation of Disturbed Areas

Objective: To establish an adequate vegetative cover on disturbed sites to prevent erosion.

Practice: Use native vegetation that allows natural succession to occur. Avoid interference with reforestation operations. Include application of seed, mulch, and fertilizer as necessary. Complete prior to fall rains.

VIII. Silviculture

A. Site Preparation

1. Gross Yarding

Objective: To achieve cool burn on sensitive soils and maintain protective duff layer.

Practice:

1. Consider the following in writing a prescription for gross yarding to reduce burn intensities: long-term site productivity, ecosystem dynamics, regeneration success, prescribed fire intensities, and smoke emissions.

2. Prescribed Fire - Underburn and Concentration Burn

a. General Guidelines

Objective: To maintain long-term site productivity of soil.

Practice: Evaluate need for burning based on soils, plant community, and site preparation criteria. Burn under conditions when a light burn can be achieved (see guidelines below) to protect soil productivity.

1. Category 1 Soils (highly sensitive): burn only in spring-like conditions when soil and duff are moist. Maximize retention of duff layer. Assure retention of minimum levels of coarse woody debris and recruitment snags as specified in Appendix JJ.

2. Category 2 Soils (moderately sensitive): burn only in spring-like conditions when soil and duff are moist. Maximize retention of duff layer. Assure retention of minimum levels of coarse woody debris and recruitment snags as specified in Appendix JJ. Write fire prescriptions that reduce disturbance and duration and achieve low fire intensity.

3. Category 3 Soils (least sensitive): burn to avoid high intensity (severe) burns to protect a large percentage of the nutrient capital. Maximize retention of duff layer. Assure retention of minimum levels of coarse woody debris and recruitment snags as specified in Appendix JJ.

Table AA-2. Guidelines for Levels of Prescribed Burn Intensity		
Visual Characterization	**Site-Specific Results**	**Proportional Area**
Light burn	The surface duff layer is often charred by fire but not removed. Duff, crumbled wood or other woody debris is partly burned, logs not deeply charred.	Less than 2 percent is severely burned. Less than 15 percent is moderately burned.
Moderate burn	Duff, rotten wood, or other woody debris partially consumed; logs may be deeply charred but mineral soil under the ash not appreciably changed in color.	Less than 10 percent is severely burned. More than 15 percent is moderately burned.
Severe burn	Top layer of mineral soil significantly changed in color, usually to reddish color; next 1/2 inch blackened from organic matter charring by heat conducted through top layer.	More than 10 percent is severely burned. More than 80 percent is moderately burned. Remainder is lightly burned.

b. Firelines

Objective: To minimize soil disturbance, soil compaction, soil erosion, and disturbance to riparian reserves.

Practices:

1. Construct firelines by hand on all slopes greater than 35 percent.

2. Utilize one-pass construction with a brush blade for tractor firelines.

3. Construct waterbars on tractor and hand firelines according to guidelines in section VII.B.1.

4. No machine constructed firelines in riparian reserves.

3. Prescribed Fire - Piling

a. Hand Piling

Objective: To prevent soil damage due to high burn intensity.

Practice: Burn piles when soil and duff moisture are high.

b. Tractor Piling

Objective: To protect soil productivity and to prevent soil damage due to compaction, displacement, and high burn intensity.

Practices:

1. Restrict tractor operations to dry conditions with less than 25 percent soil moisture content in the upper six inches of soil.

2. Restrict tractors to slopes less than 20 percent.

3. Construct small diameter piles or pile in windrows using brush blades.

4. Avoid piling concentrations of large logs and stumps.

5. Pile small material (3 to 8 inches diameter size).

6. Burn piles when soil and duff moisture are high.

7. Rip entire area to maintain soil productivity except that occupied by piles. Use winged ripper teeth and rip on contour to minimum depth of 12 inches. No ripping on clayey soils (i.e., soil series 706, 708, 840, 850).

8. Avoid displacement of duff and topsoil into piles or windrows.

9. Make only two machine passes (one round trip) over the same area wherever practical.

10. Use the lowest ground pressure machine capable of meeting objectives.

B. Fertilization

Objective: To protect water quality and to avoid impacts that retard or prevent attainment of the Monument Aquatic Conservation Strategy objectives.

Practices:

1. Avoid aerial application when wind speeds would cause drift.

2. Locate heliports and storage areas away from riparian reserves.

3. No application within riparian reserves.

4. Avoid direct application to ephemeral stream channels.

IX. Special Forest Products

A. Roads

Objective: To prevent erosion and water quality degradation.

Practices:

1. Utilize seasonal restriction on harvesting if access is by an unsurfaced road.

2. Clean all road surfaces, ditches, and catchbasins of debris from harvesting.

B. Harvest

Objective: To minimize soil damage, soil erosion, and aquatic and riparian habitat degradation.

Practices:

1. Follow practices listed in section VII. A.

2. Use an interdisciplinary team that includes a soil scientist, hydrologist, and fisheries biologist to review proposed special forest product collection/harvest activities within a riparian reserve.

X. Livestock Grazing

Objective: To protect, maintain, or improve water quality, aquatic habitat, riparian-wetland areas and upland plant communities; to achieve properly functioning riparian ecosystems.

Practices:

1. Consider fencing springs, seeps, and water developments to protect water quality, aquatic habitat, and riparian ecosystems.

2. Ensure rest for plant growth and vigor during the critical growing period.

3. Monitor, evaluate, and adjust livestock management practices to meet resource objectives.

4. Resolve management conflicts through the development of grazing management plans.

5. Promote ecological recovery through appropriate forage utilization levels.

6. Develop and implement recovery plans for riparian areas.

XI. Wildfire

A. Prevention

Objective: To minimize occurrence of severe intensity wildfires in riparian reserves, on category 1 soils, and high risk drainage areas.

Practice: Utilize prescribed burning to reduce both natural and management related slash (fuel) adjacent and/or within these areas.

B. Suppression

Objective: To minimize water quality degradation while achieving rapid and safe suppression of a wildfire.

Practices:

1. Apply the appropriate level of wildfire suppression which considers impacts of the wildfire as well as the suppression action.

2. Construct firelines by hand within riparian reserves.

3. Apply aerial retardant adjacent to riparian reserves by making passes parallel to riparian reserves.

C. Rehabilitation

Objective: To protect water quality and soil productivity with consideration for other resources.

Practices:

1. Utilize vegetation classification information as the framework for prescribing rehabilitation activities.

2. Develop a fire rehabilitation plan through an interdisciplinary process.

3. Select treatments on the basis of on-site values, downstream values, probability of successful implementation, social and environmental considerations (including protection of native plant community), and cost as compared to benefits.

4. Erosion control seeding should attempt to meet the intent of ecosystem based management objectives. Use seed availability information to prioritize erosion control seeding. First priority should be native seed sources for grasses and forbs, followed by annual grasses and forbs, and the lowest priority should be the use of perennial grasses.

5. Examples of emergency fire rehabilitation treatments include:

   a. Seeding or planting native species or other nitrogen fixing vegetation that accomplishes necessary erosion control and meets site restoration objectives.

   b. Mulch with straw or other suitable material.

   c. Fertilize.

   d. Place channel stabilization structures.

   e. Place trash racks above road drainage structures.

   f. Construct waterbars on firelines.

   g. Install stream channel structures to trap sediment in intermittent streams or dry draws.

XII. Watershed Restoration

Watershed restoration is a key component of the Monument Aquatic Conservation Strategy and is based on watershed analysis.

A. Roads

See sections VI. F., VI. G., and VI. K.

B. Riparian Vegetation

Objective: To restore the species composition and structural diversity of plant communities in riparian areas and wetlands that will provide adequate vegetative cover for shade and erosion control.

Practices:

1. Consider riparian treatments such as planting unstable areas along streams and flood terraces, planting riparian areas lacking vegetation due to past management activities, fencing to exclude livestock, and thinning densely-stocked young stands to encourage development of large conifers.

2. Assign high priority for restoration to riparian areas adjacent to water quality limited streams.

C. In-Stream Habitat Structures

Objective: To minimize damage to streambanks and riparian habitat during construction of in-stream habitat improvement projects.

Practices:
1. Carefully plan access needs for individual work sites within a project area to minimize exposure of bare soil, compaction, and possible damage to tree roots. Utilize existing trails to the extent practical.

2. Base design of habitat improvement structures on state-of-the-art techniques and local stream hydraulics.

3. Follow ODFW guidelines for timing of in-stream work (section VI.A.6.).

4. Follow applicable practices in section VI.D.2.

5. Keep equipment out of streams to extent possible. Inspect all mechanized equipment daily to help ensure toxic materials such as fuel and hydraulic fluid do not enter the stream.

6. Minimize the number and length of access points through riparian areas.

7. Limit the amount of streambank excavation to the minimum necessary to ensure stability of enhancement structures. Place excavated material as far above the high water mark as possible to avoid entry into the stream.

8. Obtain logs for habitat improvement structures from outside the riparian reserve or at least 200 feet from the stream channel, whenever possible, to maintain integrity of riparian habitat and streambanks.

9. Stabilize bare soil areas and control sedimentation through methods such as waterbars, barricades, planting, and seeding with native seed mixes.

D. Uplands

Objective: To increase soil stability, reduce soil erosion, and improve hydrologic functions.

Practice: Use corrective measures to repair degraded watershed conditions and rehabilitate with an ecologically appropriate vegetative cover that will maintain or improve soil stability, reduce surface runoff, increase infiltration, and reduce flood occurrence and flood damages.

Appendix BB - Monument Aquatic Conservation Strategy

The Monument Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within the CSNM. This conservation strategy employs several tactics to approach the goal of maintaining the "natural" disturbance regime. Land use activities need to be limited or excluded in those parts of the watershed prone to instability. Management activities within the Monument must minimize increases in peak streamflows. Headwater riparian areas need to be protected, so that when debris slides and flows occur they contain coarse woody debris and boulders necessary for creating habitat farther downstream. Riparian areas along larger channels need protection to limit bank erosion, ensure an adequate and continuous supply of coarse woody debris to channels, and provide shade and microclimate protection.

Any species-specific strategy aimed at defining explicit management actions for habitat elements would be insufficient for protecting even the targeted species. The Monument Aquatic Conservation Strategy (MACS) must strive to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources and restore currently degraded habitats. This approach seeks to prevent further degradation and restore habitat over the Monument landscape in conjunction with MACS objectives in watersheds outside the Monument. Because it is based on natural disturbance processes, it may take decades, possibly more than a century, to accomplish all of its objectives. Some improvements in aquatic ecosystems, however, can be expected within 10 to 20 years.

The important phrases in these management actions are "meet Monument Aquatic Conservation Strategy objectives," "does not retard or prevent attainment of Monument Aquatic Conservation Strategy objectives," and "attain Monument Aquatic Conservation Strategy objectives. " These phrases, coupled with the phrase "maintain and restore" within each of the Monument Aquatic Conservation Strategy objectives, define the context for agency review and implementation of management activities. Complying with the Monument Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain the existing condition or implement actions to restore conditions. The baseline from which to assess maintaining or restoring the condition is developed through a watershed analysis. Improvement relates to restoring biological and physical processes within their ranges of natural variability.

Proposed activities will be evaluated to determine their compatibility with Monument Aquatic Conservation Strategy objectives during the implementation phase. The evaluation of management actions will also focus on "meeting" and "not preventing attainment" of Monument Aquatic Conservation Strategy objectives. The intent is to ensure that a decision maker must find that the proposed management activity is consistent with the Monument Aquatic Conservation Strategy objectives. The decision maker will use the CSNM Plan and watershed analysis to support the finding. In order to make the finding that a project or management action "meets" or "does not prevent attainment" of the Monument Aquatic Conservation Strategy objectives, the analysis must include a description of the existing condition, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the

proposed project or management action maintains the existing condition or moves it within the range of natural variability. Management actions that do not maintain the existing condition or lead to improved conditions in the long term would not "meet" the intent of the Monument Aquatic Conservation Strategy and thus, would be amended or not implemented.

Monument Aquatic Conservation Strategy Objectives

The CSNM will be managed to:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and/or restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

Components of the Monument Aquatic Conservation Strategy

Riparian Reserves: Lands along streams and unstable and potentially unstable areas where special Monument guidelines direct land use.

Key Watersheds: A system of large refugia comprising watersheds that are crucial to at risk fish species and stocks and provide high quality water.

Watershed Analysis: Procedures for conducting analysis that evaluates geomorphic and ecologic processes operating in specific watersheds. This analysis should enable watershed planning that achieves Monument Aquatic Conservation Strategy objectives. Watershed Analysis provides the basis for monitoring and restoration programs and the foundation from which Riparian Reserves can be delineated. Watershed analyses have been written for the Jenny Creek and Klamath River-Irongate Watersheds and the Upper Bear Creek Watershed Analysis area. The Klamath National Forest has the lead for preparing the Cottonwood Creed watershed analysis, which they anticipated will be completed in 2003.

Watershed Restoration: A comprehensive, long-term program of watershed restoration to restore watershed health and aquatic ecosystems, including the habitats supporting fish and other aquatic and riparian-dependent organisms.

These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. The Old-Growth Emphasis Area is an important component of the Monument Aquatic Conservation Strategy. The management actions under which the Old-Growth Emphasis Area is managed will provide long-term increased protection for all stream types and may offer core areas of high quality stream habitat that will act as refugia and centers from which degraded areas can be recolonized as they recover. Streams in the Old-Growth Emphasis Area may be particularly important for endemic or locally distributed fish species and stocks.

Riparian Reserves

Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special management actions apply. These management actions prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the Monument Aquatic Conservation Strategy objectives. Riparian Reserves include those portions of a watershed directly coupled to streams and rivers, that is, the portions of a watershed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing waterbodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Riparian Reserves are primary source areas for wood and sediment such as unstable and potentially unstable areas in headwater areas and along streams. Riparian Reserves occur at the margins of standing and flowing water, intermittent stream channels and ephemeral ponds, and wetlands. Riparian Reserves generally parallel the stream network but also include other areas necessary for maintaining hydrologic, geomorphic, and ecological processes.

Under the Monument Aquatic Conservation Strategy, Riparian Reserves are used to maintain and restore riparian structures and functions of intermittent streams, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and

plants, and provide for greater connectivity of the watershed. The Riparian Reserves will also serve as connectivity corridors within the Monument.

Interim widths for Riparian Reserves necessary to meet Monument Aquatic Conservation Strategy objectives for different waterbodies are established based on ecologic and geomorphic factors. These widths are designed to provide a high level of fish habitat and riparian protection until watershed and site analysis can be completed. Watershed analysis identified critical hillslope, riparian, and channel processes that must be evaluated in order to delineate Riparian Reserves that assure protection of riparian and aquatic functions. Riparian Reserves are delineated during implementation of site-specific projects based on analysis of the critical hillslope, riparian, and channel processes and features. Although Riparian Reserve boundaries may be adjusted on permanently-flowing streams, the prescribed widths are considered to approximate those necessary for attaining Monument Aquatic Conservation Strategy objectives. Post-watershed analysis Riparian Reserve boundaries for permanently-flowing streams should approximate the boundaries prescribed in these management actions. However, post-watershed analysis Riparian Reserve boundaries for intermittent streams may be different from the existing boundaries. The reason for the difference is the high variability of hydrologic, geomorphic and ecologic processes in a watershed affecting intermittent streams. At the same time, any analysis of Riparian Reserve widths must also consider the contribution of these reserves to other, including terrestrial, species. Watershed analysis should take into account all species that were intended to be benefitted by the prescribed Riparian Reserve widths. Those species include fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, bats, and Northern Spotted Owls. The specific issue for Northern Spotted Owls is retention of adequate habitat conditions for dispersal.

Surveys to determine riparian reserves have been completed in portions of Upper Emigrant, Keene Creek, and Middle Jenny Creek Subwatersheds. The prescribed minimum widths of Riparian Reserves, listed below, apply to all watersheds in the CSNM. A site-specific analysis may be conducted and the rationale for adjusting Riparian Reserve boundaries may be presented through the appropriate NEPA decision-making process during the implementation of project level activities. The adjustments of Riparian Reserve boundaries would be consistent with attaining Monument Aquatic Conservation Strategy objectives.

Riparian Reserve Widths

Fish-bearing streams

Riparian reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.

Permanently flowing non-fish-bearing streams

Riparian reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

Constructed ponds and reservoirs, and wetlands greater than 1 acre

Riparian reserves consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or to 150 feet slope distance from the edge of a wetland greater than one acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.

Lakes and natural ponds

Riparian reserves consist of the body of water and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.

Seasonally flowing or intermittent streams, wetlands less than 1 acre, springs, and unstable and potentially unstable areas

This category applies to features with high variability in size and site-specific characteristics. At a minimum the riparian reserves will include:

The extent of unstable and potentially unstable areas;

The stream channel and the area extending to the top of the inner gorge;

The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation;

The area extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest.

Swales or dry draws. Riparian reserves in these hydrologic features will extend for approximately 25 feet on either side of the middle of the draw. Dry draws are identified as any hydrologic feature that does not meet the criteria for consideration as a perennial or intermittent stream. No surface disturbing activities such as yarding and road construction would occur, and vegetation should not be removed from the inside of dry draws and swales. A defined riparian reserve may not be necessary but these areas should be evaluated by an interdisciplinary team before any such management.

A site-potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class.

Intermittent streams are defined as any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two criteria.

Wetlands, Seeps and Springs

The combinations of hydrology, soils, and vegetative characteristics are the primary factors influencing the development of wetland habitats. There must be the presence of surface water or saturated soils to significantly reduce the oxygen content in the soils to zero or near zero concentrations. These low or zero soil oxygen conditions must persist for sufficient duration to promote development of plant communities that have a dominance of species adapted to survive and grow under zero oxygen conditions. These wetland characteristics apply when defining wetlands for regulatory jurisdiction or for technical analysis when conducting inventories or functional assessments. Seeps and springs can be classified as streams if they have sufficient flow in a channel or as seasonal or perennial

wetlands under the criteria defined in the 1987 Corps of Engineers Wetlands Manual. The management actions for wetlands, which are based on the hydrologic, physical and biologic characteristics described in the manual, apply to seeps and springs regardless of their size.

Formal definition for implementing section 404 of the Clean Water Act, adopted by the Environmental Protection Agency, is as follows:

The term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Detailed technical methods have been developed to assist in identification of wetlands that meet the above definition. Currently, the field manual being used for implementing the Clean Water Act is the "1987 Corps Manual. "

For purposes of conducting the National Wetland Inventory, the Fish and Wildlife Service has broadly defined both vegetated and non-vegetated wetlands as follows:

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Wetlands typically occur within and adjacent to riparian zones. It is frequently difficult to differentiate wetlands from riparian areas based on the definitions. Most typically, and particularly in forested landscapes, the riparian zone is defined by its spatial relation to adjacent streams or rivers. However, riparian zones are also commonly considered to be lands integrally related to other aquatic habitats such as lakes, reservoirs, intermittent streams, springs, seeps, and wetlands.

Because of such conceptual and definitional vagaries, there is spatial overlap between wetlands and riparian zones. This then results in only a portion of the riparian zone associated with rivers and streams being considered as wetlands. The extent of that portion will depend on the specifics of hydrologic, vegetation, and soil features. The functions of the wetland portion may also be distinct from the nonwetlands. For example, wetlands may provide habitat for specialized plant species or reproductive habitat for amphibians or other organisms that would not be provided by riparian areas.

Once the Riparian Reserve width is established, land management activities allowed in the Riparian Reserve will be directed by management actions for managing Riparian Reserves. The management actions for Riparian Reserves prohibit or regulate activities in Riparian Reserves that retard or prevent attainment of the Monument Aquatic Conservation Strategy objectives.

Summary of Monument Aquatic Conservation Strategy for Riparian Reserves:

- Involves portions of the landscape where riparian-dependent and stream resources receive primary emphasis.

- Riparian Reserves are designated for all permanently-flowing streams, lakes, wetlands, intermittent streams, and dry draws.

- Riparian Reserves include the body of water, inner gorges, all riparian vegetation, 100-year floodplain, landslides and landslide prone areas.

- Reserve widths are based on some multiple of a site-potential tree or a prescribed slope distance, whichever is greater. Reserve widths may be adjusted, based watershed analysis or site specific analysis during the project implementation phase, to meet Monument Aquatic Conservation Strategy objectives.

- Management actions prohibit programmed timber harvest, and manage roads, grazing, mining and recreation to achieve objectives of the Monument Aquatic Conservation Strategy.

Key Watersheds

Jenny Creek watershed is the only watershed within the CSNM that has a Tier 1 key watershed designation. Jenny Creek is a Tier 1 key watershed because it meets the qualifications of either providing, or expected to provide, high quality habitat. A system of Key Watersheds that serve as refugia is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. These refugia include areas of high quality habitat as well as areas of degraded habitat. The high quality conditions of Jenny Creek watershed will serve as anchors for the potential recovery of depressed stocks. The areas of lower quality habitat have a high potential for restoration and will become future sources of high quality habitat with the implementation of a comprehensive restoration program (see Watershed Restoration later in this section of these management actions).

Roadless Areas and Key Watersheds

The amount of existing system and non-system roads within the Jenny Creek Key Watershed should be reduced through decommissioning. Road closures with gates or barriers do not qualify as decommissioning or a reduction in road mileage. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds. That is, for each mile of new road constructed, at least one mile of road would be decommissioned, and priority given to roads that pose the greatest risks to riparian and aquatic ecosystems.

Watershed Analysis

Watershed Analysis has followed the process described in AEcosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis, version 2.2.

Watershed Restoration

Watershed restoration will be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality in the CSNM. Restoration will be based on watershed analysis and planning. In many watersheds the most critical restoration needs occur on private lands downstream from federally managed lands. Efforts would be made to work with private land owners adjacent to the CSNM in addressing restoration needs.

The most important components of a watershed restoration program are control and prevention of road-related runoff and sediment production, restoration of the condition of riparian vegetation, and restoration of in-stream habitat complexity. Other restoration opportunities exist, such as meadow and wetland restoration and mine reclamation, and these may be quite important in some areas. Decisions to apply a given treatment depend on the value and sensitivity of downstream uses, transportation needs, social expectations, risk assessment of probable outcomes for success at correcting problems, costs, and other factors.

Roads

Road treatments range from full decommissioning (closing and stabilizing a road to eliminate potential for storm damage and the need for maintenance) to simple road upgrading, which leaves the road open. Upgrading can involve practices such as removing soil from locations where there is a high potential of triggering landslides, modifying road drainage systems to reduce the extent to which the road functions as an extension of the stream network, and reconstructing stream crossings to reduce the risk and consequences of road failure or washing out at the crossings.

Riparian Vegetation

Active silvicultural programs will be necessary to restore large conifers in Riparian Reserves. Appropriate practices may include planting unstable areas such as landslides along streams and flood terraces, thinning densely-stocked young stands to encourage development of large conifers, releasing young conifers from overtopping hardwoods, and reforesting shrub and hardwood-dominated stands with conifers. These practices can be implemented in conjunction with silvicultural treatments in adjacent uplands areas, although the practices will differ in objective and, consequently, design.

In-Stream Habitat Structures

In-stream restoration, based on the interpretation of physical and biological processes and deficiencies identified during watershed analysis, can be an important component of an overall program for restoring fish and riparian habitat. In-stream restoration measures are inherently short-term and must be accompanied by riparian and up-slope restoration to achieve long-term watershed restoration. Maintaining desired levels of channel habitat complexity, for example, may best be achieved in the short-term by introducing structures. In this context, the word structures refers to logs and/or boulders strategically placed to enhance aquatic habitat quality. However, a riparian area with the complete array of functions and processes should provide coarse woody debris to the channel in the long-term.

In-stream restoration will be accompanied by riparian and up-slope restoration if watershed restoration is to be successful. In-stream restoration, including in-channel structures, will not be used to mitigate for management actions that degrade existing habitat, as a substitute for habitat protection, or to justify risky land management activities and practices. Priority must be given to protecting existing high quality habitat.

Summary of Monument Aquatic Conservation Strategy for Watershed Restoration:

- Watershed restoration restores watershed processes to recover degraded habitat.
- Watershed restoration should focus on removing and upgrading roads.
- Silvicultural treatments may be used to restore large conifers in Riparian Reserves.
- Watershed restoration should restore channel complexity. In-stream structures should only be used in the short term and not as a mitigation for poor land management practices.

Management Actions/Direction for Riparian Reserves

As a general rule, management actions/direction for riparian reserves prohibits or regulates activities that retard or prevent attainment of Monument Aquatic Conservation Strategy objectives and riparian reserve objectives. Watershed analysis and appropriate NEPA compliance will be required to change riparian reserve boundaries in all watersheds.

Management Actions/Direction - General

Apply the management actions/direction in the Special Status Species Standards and Guidelines (Appendix Z of CSNM DRMP).

Management Actions/Direction - Vegetation Management

1. Prohibit timber harvest including fuelwood cutting in riparian reserves, with the following exceptions:

   a. Allow salvage and fuelwood cutting if required to attain Monument Aquatic Conservation Strategy and Riparian Reserve objectives where catastrophic events such as fire, flooding, volcanic, wind, or insect damage results in degraded riparian conditions;

   b. Remove salvage trees only when present and future woody debris needs are met and other Monument Aquatic Conservation Strategy and Riparian Reserve objectives are not adversely affected; and

   c. Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Management Actions/Direction - Roads Management

1. Cooperate with Federal, State, and county agencies and work with private parties with road use agreements to achieve consistency in road design, operation, and maintenance necessary to attain Monument Aquatic Conservation Strategy and riparian reserve objectives.

2. For each existing or planned road, meet Monument Conservation Strategy and riparian reserve objectives by:

a. Avoiding the construction of roads and landings in Riparian Reserves unless approved by interdisciplinary team consisting of fisheries biologist, hydrologist and soil scientist.

b. preparing road design criteria, elements, and standards that govern construction and reconstruction;1.

c. preparing operation and maintenance criteria that govern road operation, maintenance, and management;

d. minimizing disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow;

e. restricting sidecasting as necessary to prevent the introduction of sediment to streams; and

f. avoiding wetlands entirely when constructing new roads.

3. Determine the influence of each road on the Monument Aquatic Conservation Strategy and Riparian Reserve objectives through watershed analysis. Meet Monument Aquatic Conservation Strategy and Riparian Reserve objectives by:

a. reconstructing roads and associated drainage features that pose a substantial risk;

b. prioritizing reconstruction based on current and potential impact to riparian resources and the ecological value of the riparian resources affected; and

c. closing and stabilizing, or obliterating and stabilizing roads based on the ongoing and potential effects to Monument Aquatic Conservation Strategy and riparian reserve objectives and considering short-term and long-term transportation needs.

New culverts, bridges and other stream crossings shall be constructed, and existing culverts, bridges, and other stream crossings determined to pose a substantial risk to riparian conditions will be improved to accommodate at least a 100-year flood, including associated bedload and debris. Priority for upgrading will be based on the potential impact and the ecological value of the riparian resources affected. Crossings will be constructed and maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.

Minimize sediment delivery to streams from roads. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is infeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hill slopes.

Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams (e.g., streams that can be made available to anadromous fish by removing obstacles to passage).

Develop and implement a road management plan or a transportation management plan that will meet the Monument Aquatic Conservation Strategy and riparian reserve objectives. As a minimum, this plan will include provisions for the following activities:

- inspections and maintenance during storm events;

- inspections and maintenance after storm events;

- road operation and maintenance giving high priority to identifying and correcting road drainage problems that contribute to degrading riparian resources;

- traffic regulation during wet periods to prevent damage to riparian resources; and

- establishing the purpose of each road by developing the road management objectives.

Management Actions/Direction - Grazing Management

Through a planning and environmental analysis process appropriate to the action, adjust or eliminate grazing practices that retard or prevent attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Locate new livestock handling and/or management facilities outside Riparian Reserves. For existing livestock handling facilities inside Riparian Reserves, ensure that Monument Aquatic Conservation Strategy and Riparian Reserve objectives are met. Where these objectives cannot be met, require relocation or removal of such facilities.

Limit livestock trailing, bedding, watering, loading, and other handling efforts to those areas and times that will ensure Monument Aquatic Conservation Strategy and Riparian Reserve objectives are met.

Management Actions/Direction - Recreation Management

If new recreational facilities are designed within Riparian Reserves, including trails and dispersed sites, so as not to prevent meeting Monument Aquatic Conservation Strategy and riparian reserve objectives. Construction of these facilities should not prevent future attainment of these objectives. For existing recreation facilities within Riparian Reserves, evaluate and mitigate impacts to ensure that these do not prevent, and to the practicable extent contribute to, attainment of Monument Aquatic Conservation Strategy and riparian reserve objectives.

Adjust dispersed and developed recreation practices that retard or prevent attainment of Monument Aquatic Conservation Strategy and riparian reserve objectives. Where adjustment measures such as education, use limitations, traffic control devices, increased maintenance, relocation of facilities, and/or specific site closures are not effective, eliminate the practice or occupancy.

Address attainment of Monument Aquatic Conservation Strategy, riparian reserve objectives in and wilderness management plans. Management Actions/Direction - Fire/Fuels Management

Design fuel treatment, fire suppression strategies, practices, and activities to meet Monument Aquatic Conservation Strategy and Riparian Reserve objectives, and to minimize disturbance of riparian ground cover and vegetation. Strategies will recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management activities could be damaging to long-term ecosystem function.

Locate incident bases, camps, helibases, staging areas, helispots and other centers for incident activities outside of Riparian Reserves. If the only suitable location for such activities is within the riparian reserve, an exemption may be granted following a review

and recommendation by a resource advisor. The advisor will prescribe the location, use conditions, and rehabilitation requirements. Utilize an interdisciplinary team to predetermine suitable incident base and helibase locations.

Minimize delivery of chemical retardant, foam, or other additives to surface waters. An exception may be warranted in situations where overriding immediate safety imperatives exists, or following a review and recommendation by a resource advisor when an escape would cause more long-term damage.

Design prescribed burn projects and prescriptions to contribute to attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Immediately establish an emergency team to develop a rehabilitation treatment plan needed to attain Monument Aquatic Conservation Strategy and Riparian Reserve objectives whenever Riparian Reserves are significantly damaged by a wildfire or a prescribed fire burning outside prescribed parameters.

Consider rapidly extinguishing smoldering coarse woody debris and duff.

Locate and manage water drafting sites (e.g., sites where water is pumped to control or suppress fires) to minimize adverse effects on riparian habitat and water quality as consistent with Monument Aquatic Conservation Strategy and riparian reserve objectives.

Management Actions/Direction - Land Management

Issue leases, permits, rights-of-way, and easements to avoid adverse effects that retard or prevent attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives. Where legally possible, adjust existing leases, permits, rights-of-way, and easements to eliminate adverse effects that retard or prevent the attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives. If adjustments are not effective and where legally possible, eliminate the activity. Priority for modifying existing leases, permits, rights-of-way and easements will be based on the actual or potential impact and the ecological value of the riparian resources affected.

Use land acquisition, exchange, and conservation easements to meet Monument Aquatic Conservation Strategy and Riparian Reserve objectives to facilitate restoration of fish stocks and other species at risk of extinction.

Management Actions/Direction - General Riparian Area Management

Identify and attempt to secure instream flows needed to maintain riparian resources, channel conditions, and aquatic habitat.

Fell trees in Riparian Reserves when they pose a safety risk. Keep felled trees on site when needed to meet coarse woody debris objectives.

Apply herbicides, insecticides, other toxicants, and other chemicals only in a way that avoids impacts that retard or prevent attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Locate water drafting sites to minimize adverse effects on stream channel stability, sedimentation, and instream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Management Actions/Direction - Watershed and Habitat Restoration

Design and implement watershed restoration projects in a manner that promotes long-term ecological integrity of ecosystems, conserves the genetic integrity of native species, and attains Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Cooperate with Federal, State, local, and Tribal agencies, and private landowners to develop watershed-based coordinated resource management plans or other cooperative agreements to meet Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Prevent watershed and habitat degradation rather than relying on mitigation measures or planned restoration.

Management Actions/Direction - Fish and Wildlife Management

Design and implement fish and wildlife habitat restoration and enhancement activities in a manner that contributes to attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Design, construct and operate fish and wildlife interpretive and other user-enhancement facilities in a manner that does not retard or prevent attainment of Monument Aquatic Conservation Strategy and Riparian reserve objectives. For existing fish and wildlife interpretative and other user-enhancement facilities inside Riparian Reserves, ensure that Monument Aquatic Conservation Strategy and Riparian Reserve objectives are met. Where Monument Aquatic Conservation Strategy and Riparian Reserve objectives cannot be met, relocate or close such facilities.

Cooperate with Federal, Tribal, and State wildlife management agencies to identify and eliminate wild ungulate impacts that are inconsistent with attainment of Monument Aquatic Conservation Strategy and Riparian Reserve objectives.

Cooperate with Federal, Tribal, and State fish management agencies to identify and eliminate impacts associated with habitat manipulation, fish stocking, harvest and poaching that threaten the continued existence and distribution of native fish stocks occurring on Federal lands.

Management Actions/Direction - Key Watersheds

Reduce existing road mileage within key watersheds. If funding is insufficient to implement reductions, neither construct nor authorize through discretionary permits a net increase in road mileage in key watersheds. Give highest priority to watershed restoration in key watersheds.

Research

A variety of research activities may be ongoing and proposed in Key Watersheds and Riparian Reserves. These activities must be analyzed to ensure that significant risk to the watershed values does not exist. If significant risk is present and cannot be mitigated, study sites must be relocated. Some activities not otherwise consistent with the objectives may be appropriate, particularly if the activities will test critical assumptions of these

management actions; will produce results important for establishing or accelerating vegetation and structural characteristics for maintaining or restoring aquatic and riparian ecosystems; or the activities represent continuation of long-term research. These activities should be considered only if there are no equivalent opportunities outside of Key Watersheds and Riparian Reserves.

Current, funded, agency-approved research, which meets the above criteria, is assumed to continue if analysis ensures that a significant risk to Monument Aquatic Conservation Strategy objectives does not exist.

Monitoring

The following monitoring section is specific to achieving the stated objectives of the Monument Aquatic Conservation Strategy. Implementation, effectiveness, and validation monitoring need to be conducted consistent with the monitoring discussion in the Components of the Monument Monitoring Strategy (Appendix LL).

General objectives of monitoring will be to: (1) determine if Best Management Practices have been implemented, (2) determine the effectiveness of management practices at multiple scales, ranging from individual sites to watersheds, and (3) validate whether ecosystem functions and processes have been maintained or improved as predicted. In addition, monitoring will provide feedback to fuel the adaptive management process.

Specific monitoring objectives will be derived from the Monument Monitoring Strategy (Appendix LL). Monitoring at the watershed level will link monitoring for ecosystem management objectives for multiple scales of province, river basin, smaller watershed and site-specific levels. Specific locations of unstable and potentially unstable areas, roads, and vegetative management activities will be identified. In addition, the spatial relationship of potentially unstable areas and management actions to sensitive habitats such as wetlands will be determined. This information provides a basis for targeting watershed monitoring activities to assess outcomes associated with risks and uncertainties identified during watershed analyses.

Under natural conditions, stream habitats within the CSNM exhibit an extremely wide diversity of conditions depending on past disturbances, topography, geomorphology, climate and other factors. Consequently, riparian area monitoring must be dispersed among the various landscapes rather than concentrated at a few sites and then extrapolated to the entire monument. Logistical and financial constraints require a stratified monitoring program that includes:

- Post-project site review
- Reference to subwatersheds and drainage areas
- Watershed monitoring
- A water quality network
- Landscape integration of monitoring data

A stratified monitoring program examines watersheds at several spatial and temporal scales. Information is provided on hillslope, floodplain, and channel functions, water quality, fish and wildlife habitat and populations, and vegetation diversity and dynamics.

Parameters selected for monitoring depend on the activities planned for a given watershed designed to specifically address management activities with the Monument. Two of the

more extensive activities related to water quality are vegetative management and road related operations. In addition to chemical and physical parameters, biological criteria may be appropriate to monitor using techniques such as Rapid Bioassessment Protocols for macroinvertebrates or the index of biotic integrity for fish diversity.

Long-term systematic monitoring in selected watersheds will be necessary to provide reference points for effectiveness and validation monitoring. These watersheds should represent a range of forest and stream conditions that have been exposed to natural and induced disturbance. Reference watersheds, sub-basins, and individual sites will be selected as part of the overall adaptive management process described as part of these management actions.

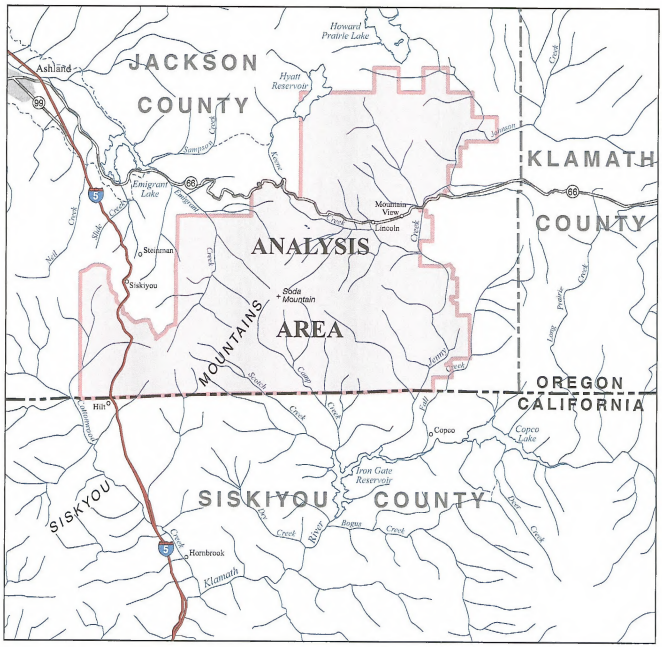
Study plans will be cooperatively developed based on province, river basin, and/or watershed level analyses. Long-term data sets from reference watersheds will provide an essential basis for adaptive management and a gauge by which to assess trends in in-stream condition.

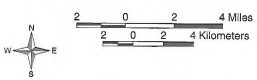
Monitoring plans must be tailored for each watershed within the Monument. Significant differences in type and intensity of monitoring will occur based on watershed characteristics and management actions. For example, carefully targeted restoration activities may only require effectiveness monitoring of single activities, whereas watershed-scale restoration would be accompanied by extensive riparian and in-stream monitoring. The specific design of monitoring programs can best be accomplished by the local interdisciplinary teams working in cooperation with state programs. Pooling the monitoring resources of federal and state agencies is a necessity to provide interagency consistency and to increase available resources.

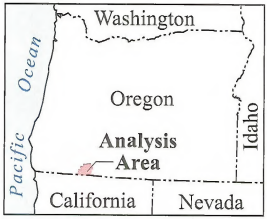
XI. Maps -

Note: The Maps were purposely numbered out of sequence.

Cascade-Siskiyou National Monument
Analysis Area Location







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MAP 1

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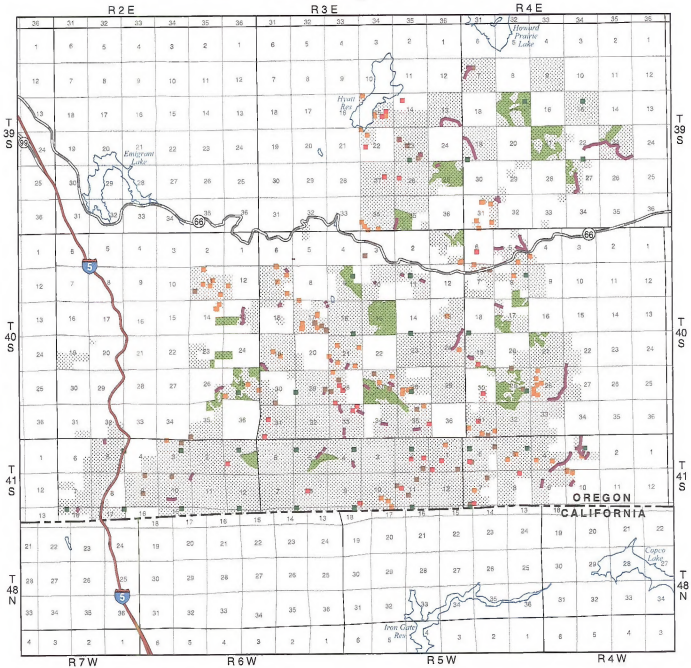
Cascade-Siskiyou National Monument
Monitoring Sites



2 0 2 4 Miles

2 0 2 4 Kilometers

N W E S

LEGEND

- Historical Plant Community Change
- Rangeland Monitoring
- Historic Wildlife Transects
- Forest Health Plots
- Forest Health
- Riparian / Fish Habitat Monitoring
- Cascade-Siskiyou National Monument

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MAP 46

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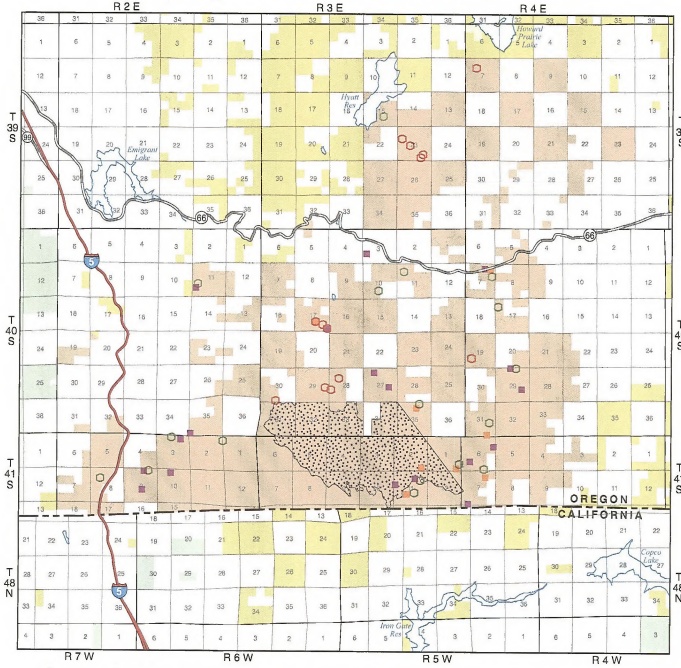
Cascade-Siskiyou National Monument
Rangeland Plots and Livestock Exclosures



2 0 2 4 Miles
2 0 2 4 Kilometers

N W E S

LEGEND

- Rangeland Utilization Plot
- Rangeland Trend Plot
- Completed Livestock Exclosure
- Proposed Livestock Exclosures
- Cascade-Siskiyou National Monument
- Other BLM Administered Land
- U.S. Forest Service
- Bureau of Reclamation
- Non-Federal Land
- Wilderness Study Area

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MAP 47

D11-05-2000:JR

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